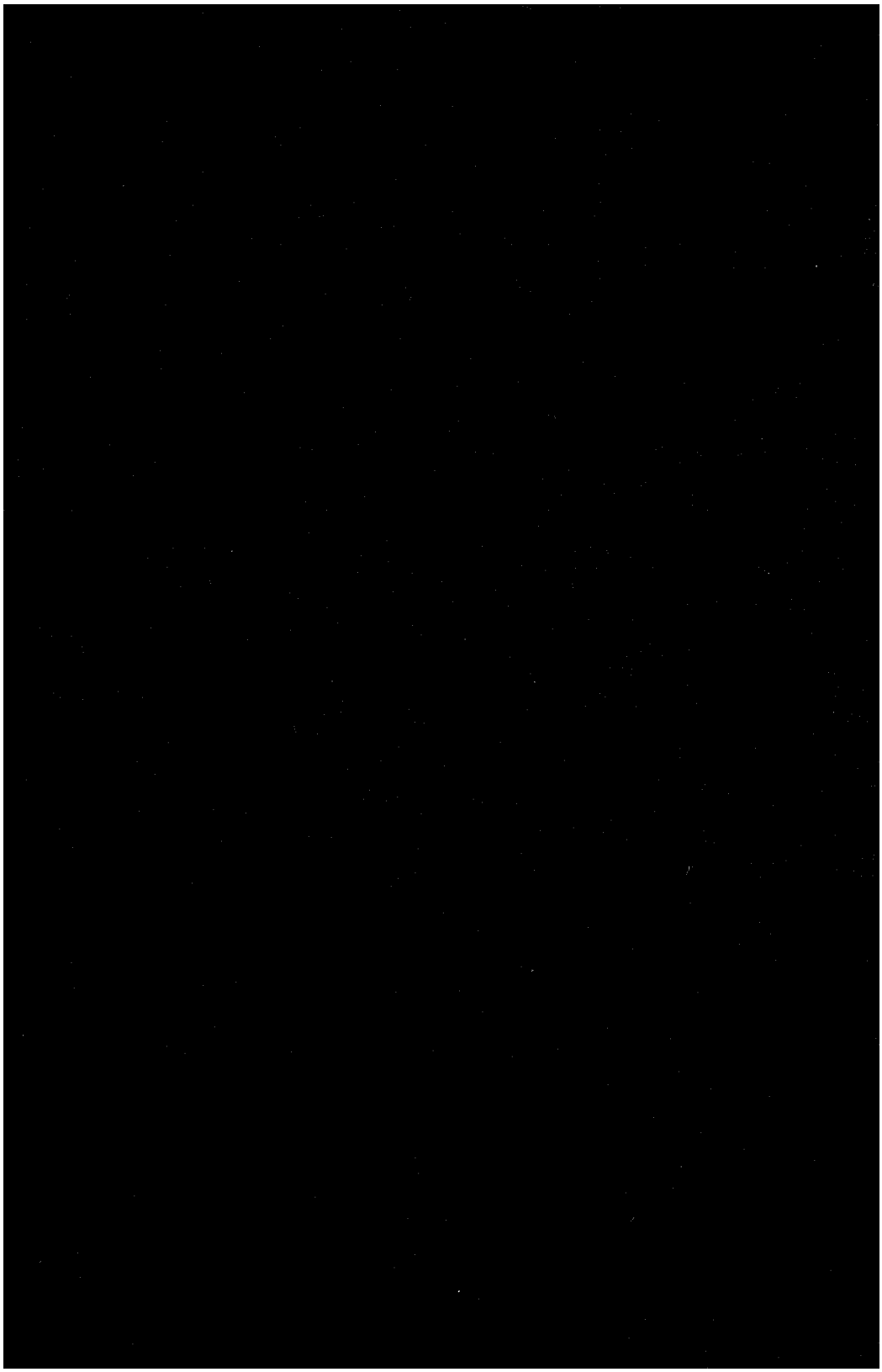


The Mineral Resources *of* Manitoba

BY

R. C. WALLACE

UNIVERSITY OF MANITOBA

WINNIPEG

ISSUED AND DISTRIBUTED BY

INDUSTRIAL DEVELOPMENT BOARD OF MANITOBA

WINNIPEG

1925

THE INDUSTRIAL DEVELOPMENT BOARD OF MANITOBA

OFFICERS

HON. JOHN BRACKEN ..... *Chairman*
W. H. CARTER ..... *Vice-Chairman*
F. M. BLACK ..... *Hon. Treasurer*
J. M. DAVIDSON ..... *Secretary*

DIRECTORS

ALD. J. A. BARRY
P. E. BEACHBOARD
F. M. BLACK
ALLAN S. BOND
HON. JOHN BRACKEN
EDW. BRODERICK
W. H. CARTER
GORDON COOPER
J. B. COYNE, K.C.
R. W. CRAIG, K.C.
W. P. DUTTON
D. R. FINKELSTEIN
H. FORD
C. J. HARDING
ALD. E. T. LEECH
H. B. LUMSDEN
W. G. MANDERS
F. H. MARSH
F. H. MARTIN
J. L. McBRIDE
J. McEACHERN
A. W. McLIMONT
WALTER OWENS
W. P. RODGERS
E. S. RUSSENHOLT
ALD. R. J. SHORE
R. V. SLAVIN
G. STEPHEN
J. F. SWEETING
A. A. TISDALE
DR. R. C. WALLACE
MAYOR R. H. WEBB
A. H. WILLIAMSON
W. E. WRIGHT

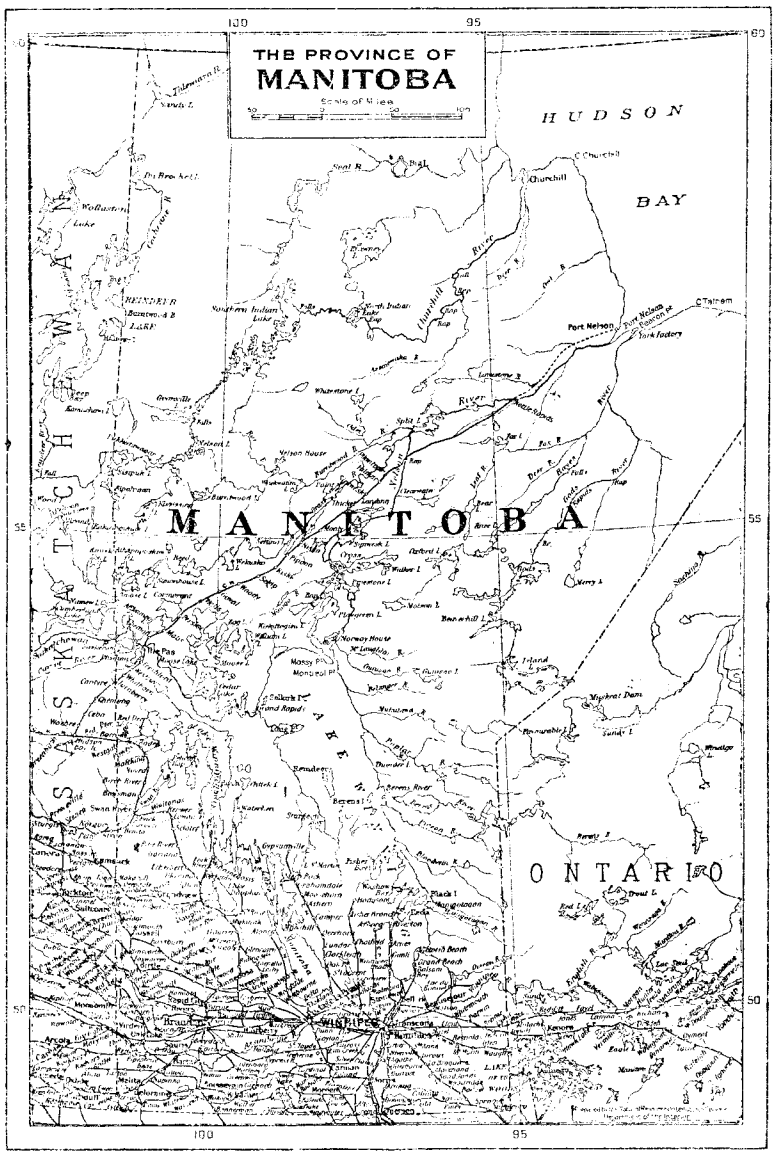


Plate I. Map of Manitoba

TABLE OF CONTENTS

ILLUSTRATIONS

Photographs Page

Plates

Map

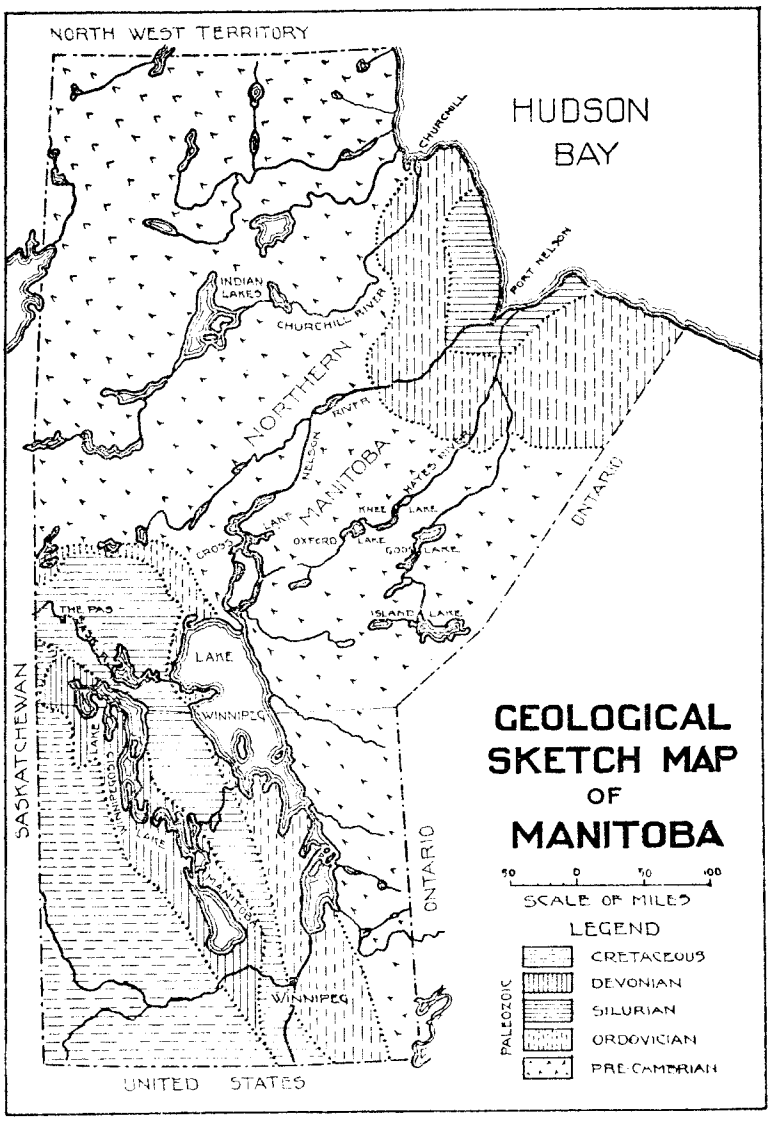


Plate II. The Geological Formation of Manitoba

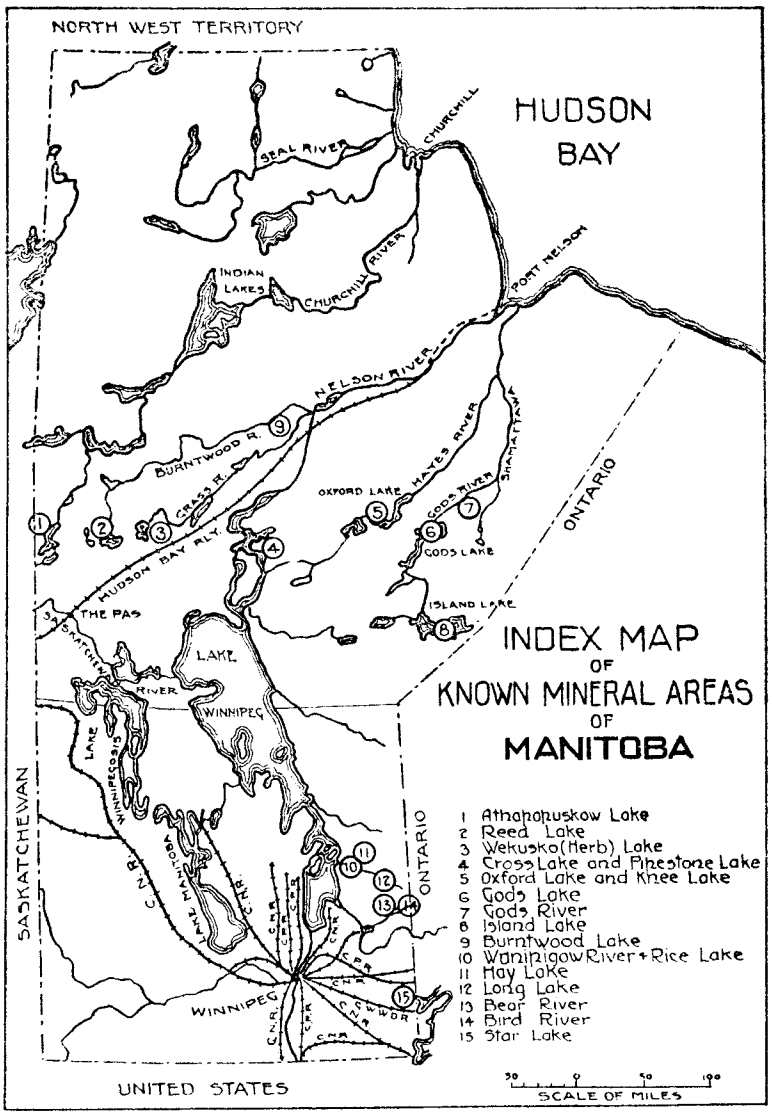


Plate III. Metallic Mineral Areas in Manitoba

PREFACE

THE purpose of this bulletin is to give a description of the various mineral resources—metallic and non-metallic—which are known to occur in the province of Manitoba. The bulletin was written after re-investigation of the more important mineral resources of the province during the summer of 1925, and may therefore be taken to represent the mineral situation as at the date of publication.

The author is indebted to various authorities, notably the Geological Survey and Mines Branches of the Department of Mines, for references and details; and to Dr. J. S. DeLury for notes on recent developments in eastern Manitoba. He desires to express his appreciation of the co-operation of the Natural Resources Intelligence Branch, Ottawa. A bibliography is appended which will be of assistance in search for fuller information on mineral resources. For details on the geological history of the province, the reader is referred to "The Geological Formations of Manitoba," by R. C. Wallace, issued by the Natural History Society of Manitoba in 1925.

This bulletin is one of a series of publications on the natural resources of Manitoba, issued in connection with the work of the Natural Resources Committee of the Industrial Development Board. After the details of the resources of the province have been assembled, it will be possible to deal with the steps that may be taken to further industrial development.

October, 1925.

THE HISTORY OF MINERAL DEVELOPMENT IN MANITOBA

The earlier work on the mineral resources of the province was confined to non-metallic materials. This was to be expected in an area where the population was massed in the agricultural lands where metallic deposits do not occur, and where building materials and other non-metallic minerals are in demand. The earliest mineral industry was the extraction of salt from the brine springs on the west side of lake Manitoba and lake Winnipegosis. From this source freedmen from the Hudson's Bay Company service manufactured salt during the period 1800-1876, and probably even earlier, and supplied the needs of the posts and settlements on the Assiniboine, Red and Saskatchewan rivers. As agricultural communities grew, and as the Fort Garry Settlement reached the proportions of a town, building materials came into demand. The outcrops of limestone at Lower Fort Garry, Bishop's Quarry, near St. Andrew's Locks, the East Selkirk beds, and later Garson (Tyndall) supplied the stone for foundations and for the more imposing buildings; while the limestone boulders which were plentifully distributed in the drift materials were everywhere burnt for lime. In the late nineties the gypsum deposits northwest of lake St. Martin were opened up, and the calcined product was conveyed by boat from old Gypsumville, on lake Manitoba, to Totogan, and thence by rail to Winnipeg. From that date there has been continuous operation of the gypsum industry, though the route is now all-rail, and the gypsum is calcined in Winnipeg. In the present century the brick industry developed at several towns in the province, a natural cement plant was established at Babcock, and a Portland cement plant at Tuxedo, with limestone drawn from lake Manitoba. Except for the years of stagnation following the war, the building material industry has been one of steady and healthy growth.

In fuels the history of development has been less encouraging. While the coal deposits of Alberta were yet untouched, considerable interest was shown in the coal seams which were known to occur in Turtle mountain in southwestern Manitoba. During the nineties of the last century mining was done on the northwestern flank of the mountain at the old McArthur mine, and at the Varden mine; but for over 20 years no coal has been mined in that area. The opening of the Estevan field, from which the first coal was brought down the Souris river to Winnipeg by barge, has made available a lignite area of much greater extent and more feasible exploitation: and the Turtle mountain area will, in future, probably serve only local demand. In many places drilling has been carried on for oil, but without success; though at Waskada and in isolated wells elsewhere natural gas has been found in quantities sufficient for local use.

The history of metalliferous mining development lies within the last fifteen years. Some prospecting had been done before 1910 in the northern areas of the province, but development work dated from that time. The stimulus which successful gold mining development in northern Ontario has given since that date to Canadian mining has had a marked effect on exploratory work in northern Manitoba. The actual result in established mining industry is as yet small. A small high-grade copper sulphide deposit was mined at the Mandy property in northwestern Manitoba during the years 1916-1919. The Rex mine has been producing gold while development work is proceeding. From the Luleo and Gold Pan properties east of lake Winnipeg some gold was produced. But during those years of search a large low-grade copper sulphide deposit was discovered in northwestern Manitoba in the Flin Flon property which has been carefully investigated, and will be developed when conditions are favourable. Gold has been found in several areas, north of the Hudson Bay railway, and east of lake Winnipeg, and important mining companies are engaged in developing prospects in those several fields. There is as well a changing attitude on the part of the people of the province, and the belief has gained ground during these years of exploration that the Precambrian areas of Manitoba—more than three-fifths of the land surface of the province—may through judicious expenditures of capital yield a return in gold and copper which will be an important contribution to the wealth of the province.

The discussion of the mineral materials is arranged in alphabetical order of the various minerals.

AMBER

A very interesting occurrence of a hydrocarbon of the amber family is that on the shore of a shallow bay of Cedar lake immediately south of the Hudson's Bay Company post (Chemahawin) on that lake. This substance is amber coloured, less transparent than a typical amber, and was found by Harrington to differ somewhat in chemical composition from a true amber, and was named by him Chemahawinite after the Hudson's Bay Company post. Lumps as large as a hen's egg have been found, but the pieces are on an average smaller than a pea. They occur on the beach of the lake, and under the water, mixed with sand and mud and decaying vegetable material. Even when selected, they are not of any value for ornamental purposes, though used by some of the older Hudson's Bay Company families in Winnipeg more from the local interest of the material than its artistic value. The material is however of value in the paint and varnish industry, and considerable interest has been taken in the deposit in recent years from that point of view. It is in small percentage in the dirt, and an effective means of separation, capable of handling large quantities of the material at small cost, would be necessary.

Chemahawinite has also been found in some of the bays at the south end of Moose lake. It is a fossil resin, from coniferous forests of presumably pre-glacial times. Harrington's analysis is as follows:

Carbon	79.96
Hydrogen	10.46
Oxygen	9.49
Ash	0.09
	100.00

ANTIMONY

Stibnite (sulphide of antimony) is found in the galena-sphalerite replacement deposits on the Little Herb river; also in quartz veins on the east side of Herb lake (Kiski and Broad bay). These occurrences are interesting mineralogically, but are not of economic significance. Of possible economic interest, however, are the solid stibnite veins which are found in sericitic schist at the west end of Oxford lake, associated with quartz and large crystals of calcite. Several tons of this ore have been cobbed for shipment.

On the east side of lake Winnipeg, near the mouth of Sandy river, a broken-off piece of native antimony was found four yeasr ago. When found, it was lying within 100 yards of the shore. While it may be purely adventitious, the fact is noted in case other pieces may be found in that area.

ARSENIC

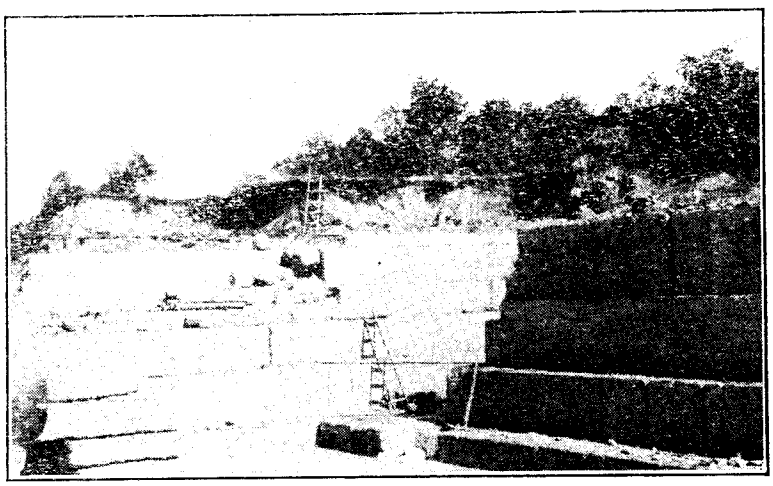
Arsenopyrite (mispickel) is widely distributed in association with gold quartz veins in the Wekusko (Herb) lake district in northern Manitoba. In places the wall rock for a width of a few inches up to a foot is almost solid arsenopyrite. Part of the gold values is carried in fine-grained arsenopyrite, and if a gold industry were established in that area, arsenic might be recovered on handling the concentrates. Arsenopyrite is found also in considerable quantity in the Star lake-Falcon lake area in eastern Manitoba in similar association.

BUILDING STONE

The following rock materials have been used for building purposes in Manitoba: (1) the limestone of East Selkirk, Lower Fort Garry and Garson (Tyndall). The quarrying is now confined entirely to the Garson locality. (2) The dolomites of Stonewall. (3) The sandstones south of Boissevain. (4) The granite and gneiss boulders which have been carried from the north by the ice. The first is the only important building material in the

province, the others having now only a historic interest. Details of occurrences will be found under *Limestone*, *Dolomite*, *Sandstone* and *Granite*. The discussion is confined here to certain phases of the industry.

The Garson (Tyndall) stone, a limestone of a mottled or variegated pattern, with blotches of buff or blue dolomite rock in the light grey limestone, is now recognized as one of the most attractive building stones in Canada, and as probably the best limestone for building purposes that Canada produces. It meets the double demand of dimension stone and interior finish stone. Its effectiveness as a dimension stone on a building of massive proportions is seen in the Legislative Buildings of Manitoba, and its value for interior finish may be noted in the Parliament Buildings in Ottawa. Apart from its use in the prairie provinces,

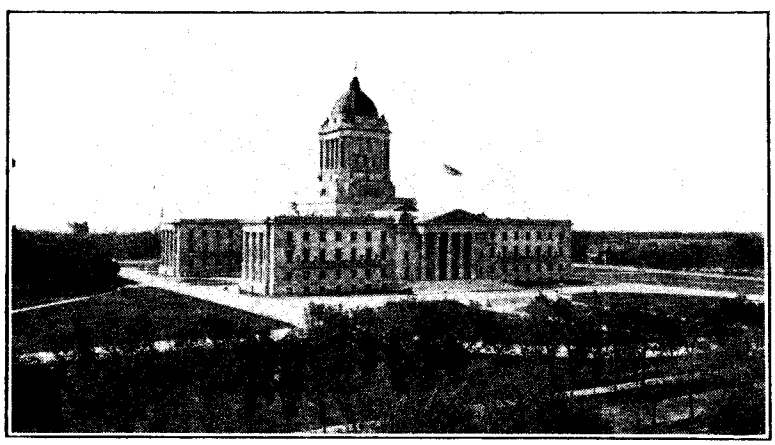


Western Stone Co. quarry, Garson (Tyndall)

it has found a market in Quebec, Montreal, Toronto, Ottawa, Hamilton, London, Cochrane and Port Arthur. The long haul to Montreal with a consequent freight rate of $246.00 on a 60,000 lb. car is a handicap to extension of the market in the east. The Bedford (Indiana) oolitic limestone, which has been the most formidable competitor to the Tyndall limestone in central Canada, cannot now compete as finished stone owing to the high duty against cut stone. In the rough, however, it can still compete with the Tyndall stone. It is more easily worked, but not so effective or decorative, and cannot be used to advantage for interior finish.

The largest quarry at Garson (Wallace Sandstone Co. quarry) is not now in operation. The mill was burnt down in 1917, and since that date, except for some sawing done at the Western Stone

Co.'s property, the stone from the quarries now in operation is shipped to Winnipeg mills to be finished. The Western Stone Co., Gillis Ltd., and Oliver and Manson now operate quarries at Garson, with a combined shipment of 18 cars per week (June, 1925). The quarry face has a maximum of 22 feet of effective rock exposed at Western Stone Co.'s quarry with 8 feet overburden. The upper beds are buff, grading into blue in the lower beds. The beds are fairly heavy, grading from 2 to 3 feet in thickness. The price of buff stone, owing to greater demand for that colour, is slightly higher than the blue; buff is quoted at approximately 60c per cubic foot in the rough, blue 50c. Cut stone is quoted at $3.00 per cubic foot on an average; if the stone were finished at the quarries, a reduction in cost of finished stone could be made, particularly for the eastern market. There is a much greater available supply of blue than of buff stone in the



Legislative Buildings, Winnipeg (Tyndall stone

quarries as now developed, and the blue stone will probably come into much greater demand in the future. Quarrying ground is still available northwest from the quarries now operated, and the stone is readily accessible as well on the west side of lake Winnipeg.

The Stonewall dolomite has been used for rough faced work in the Land Titles Building, Post Office and School at Stonewall. It is too hard for ordinary building purposes, and with the exception of the bottom bed, the quarry beds are too thin for dimension stone. As a building stone it has found no use elsewhere.

The sandstone exposed south of Boissevain is a soft greenish grey rock which hardens on exposure. It was used, mainly from 1887 to 1894, as a building stone in Boissevain, and all the important buildings of that time are built of this stone. It has hardened

with age, and has proved to be a satisfactory stone. The quarries were small, the top beds were soft, and the dip was somewhat sharply to the east into heavy overburden. The formation is probably Foxhill (Upper Cretaceous).

The granite boulders strewn over the prairies have been widely used for foundations, and to some extent for building. Several buildings at Morden and Darlingford, the Roman Catholic Church at Pine creek, and the Indian Industrial School (R.C.) at Cross lake, are illustrations of the effective use of boulder stone. Granite has not been quarried for building purposes, though a quarry on the east side of lake Winnipeg, opposite Bull head, was opened for rubble material, and operated for a short time by the Lake Winnipeg Shipping Company.

CEMENT ROCK

Cement rock is quarried in Manitoba to supply the needs of (1) the Portland cement industry, (2) the natural cement industry.

(1) **The Portland Cement Industry:**

One of the mills of the Canada Cement Company is situated at Tuxedo, in the southwestern outskirts of Winnipeg. A low-magnesian limestone is quarried at Steep Rock, lake Manitoba, crushed at the quarry, and shipped 146 miles to the mill at Tuxedo. It is there mixed with clay which is excavated from pits about a mile west of the mill, the pits ranging in depth up to 10 feet from the surface. The mixture is approximately 2 limestone to 1 clay. The finely ground mixture is clinkered at 2700°-2900° F. in rotary kilns, the clinkers mixed with raw gypsum (2%) and reground. The annual production from the mill has been in the recent years of business depression about 300,000 barrels, supplying the Canadian market from Dryden westwards to Moose Jaw. In that area no shipment of cement crosses the boundary line in either direction.

The limestone quarry at Steep Rock extends from the crusher in a direction slightly north of east for a distance of over one-half mile. The average depth is 12 feet, though on a second cut a depth of 18 feet has in places been reached. The rock is shaly, and after blasting is excavated by steam shovel. The capacity production of crushed stone is 1000 tons per day, and the present production (July, 1925) 3000 tons per week. The rock is an almost pure limestone, is very sharply mottled, with round pebble-like brown masses in the grey stone, and breaks in 3-inch beds, except at the bottom of the quarry, where the beds are somewhat heavier. There are occasional clay pockets, where the limestone has been shattered; otherwise the rock is very clean. 450 K.W. are generated at the power plant and the three crushers are operated by electric power. The freight charges to Tuxedo are 7 cents per 100 pounds.

The following is a typical analysis of the limestone at Steep Rock:

Moisture	0.09
Insoluble	1.01
Alumina and iron oxides	.35
Lime carbonate	98.73
Magnesium carbonate	1.38
Sulphur trioxide	.08
	99.64

Rocks of somewhat similar quality are found at Spearhill, Oak point, Onion point, Winnipegosis and point Wilkins.

(2) **Natural Cement**:

Natural cement is manufactured from a calcareous shale of Niobrara age, without admixture, by the Commercial Cement Company at Babcock, west of Roseisle. An 8-foot bed of this shale is mined on the room and pillar system, with 30-foot rooms and 15-foot pillars, and the roof, which is remarkably level, is supported by heavy timbering. It is found to be the best practice to run north and south rooms from east and west tunnelways. The level of the adit is 15 feet above the track level at Babcock Station, and there is a height of 140 feet of shale above the workings. The shale is mixed with coal and clinkered in a battery of 6 continuous kilns. The clinker is sent to the mill, crushed and screened, passed through a tube mill and sacked for shipment. The capacity of the plant is 250 barrels per day; there is considerable stock on hand, and the mill has not been operated during the present summer.

The market for natural cement is of a local character, Winnipeg and district taking the greater part of the product, though markets have been found as far as Dryden and Saskatoon. The Babcock cement is of a rapid hardening type, useful particularly for mortars, and in practice mixed with varying percentages of Portland cement for other purposes. There is probably a certain residue of uncombined lime in this natural cement. There is available a very large amount of cement rock in the mine, easily available at very low cost: and quickened industrial conditions should again demand full operations of this plant.

For a time (from 1904 onwards) a plant was operated at Arnold, on the Canadian Northern Railway west of Miami, where a 20-foot ledge of calcareous shale was obtained by tunnelling into the bottom of a hill of Niobrara shale, and manufactured into natural cement. This plant is now dismantled.

The following is an analysis of the calcareous shales of the Niobrara formation. They vary considerably in chemical composition:

Moisture	1.50
Silica	27.02
Alumina	9.32
Ferric oxide	4.00
Lime	35.25
Magnesia	0.50
Alkalis	1.38
Sulphur trioxide	0.82
Organic matter	0.41
Carbon dioxide	0.53
Combined water	19.27
	100.00

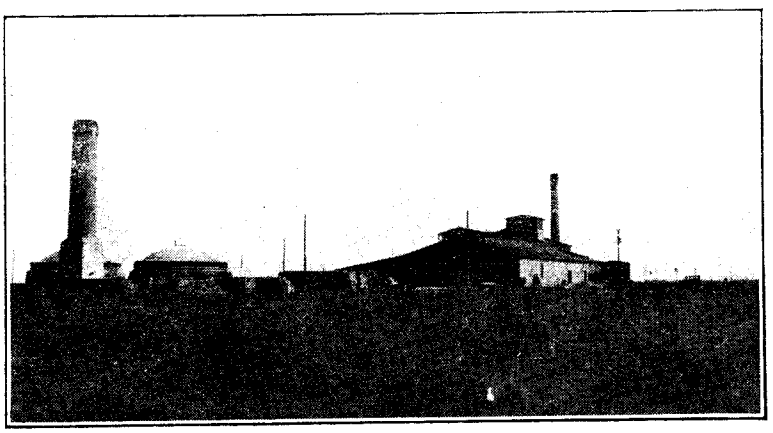
CLAYS—THE BRICK INDUSTRY

Clays are widely distributed over the surface of Manitoba. They are mainly of glacial origin, and have therefore been carried considerable distances from the parent rock. Residual clays are very rare. The kaolin of Deer (Punk) island (see *Kaolin*) is probably of this type. Where limestone underlies the clay or is exposed to the north of the clay beds (in the path of the ice sheet), the lime content of the clay is usually high. In Precambrian territory the average lime content of the clays is much lower. Surface clays suitable for brickmaking purposes in the province are of the bedded type, having been deposited in glacial lake or old river basin. They contain therefore a considerable proportion of silt, mixed with the coarse and fine clay. Beds or lenses of sand are found in the clay beds, often in sufficient amount to supply the necessary sand mixture for the manufacture of brick. The depth to which the surface clay is excavated for brick manufacture varies with the locality—from 2½ feet at St. Boniface to 18 feet at Sidney.

Brickmaking has been carried on on this type of clay at the following places in Manitoba: Winnipeg, St. Boniface, Lac du Bonnet, Whitemouth, Tyndall, Gunton, Portage la Prairie, Morris, Somerset, Cypress River, Sidney, Hartney, Brandon, Edrans, Virden, Neepawa, Gilbert Plains and Thunder Hill. Of these during the present summer (1925) bricks have been made at Winnipeg (Alsip), St. Boniface (Marion), Whitemouth, Portage la Prairie (Snider), and Gilbert Plains (Snider), with a total output of approximately 7,000,000 bricks. With the exception of the Sidney plant, where the process is stiff mud (wire cut), the soft mud process is used. Burning is done in the scove kiln, but at Sidney and Portage la Prairie down-draft kilns are in operation. The colour of the brick varies with the percentage of lime in the

clay, the high-lime clays producing pale or buff-coloured bricks. The low-lime clay of Sidney produces a red or (overburnt) chocolate brown brick. At Sidney and the Alsip plant of Winnipeg, hollow tile is manufactured by the stiff mud (wire cut) process.

The Cretaceous shales of Niobrara and Pierre age have also been used for the manufacture of brick, hollow tile and sewer piping. Brick was made at La Riviere from the Pierre shale, at Learys from the Niobrara shale, and at Carman a plant was built to make brick and sewer piping from a mixture of Niobrara and Pierre shale. These plants have been dismantled, but at Winnipeg (Winnipeg Clay Products, Ltd.) hollow tile is being manufactured (September, 1925) from a mixture of Niobrara shale from Morden and Pierre shale from La Riviere, using the stiff mud process, and burning in circular down draft kilns.



Plant of Winnipeg Clay Products, Ltd., Winnipeg

Sandlime (sandstone) brick is manufactured in Winnipeg by D. D. Wood & Sons, from sand obtained at Smith Siding, north of Molson, and low magnesia lime from Garson or Spearhill. 10% of lime freshly hydrated, is used, mixed with the sand, pressed and steamed in kettles for eight hours. The Winnipeg Brick and Fuel Company use sand from Marchand and Spearhill lime in their plant. By the addition of ochres, red, brown and yellow bricks are made, as well as the white variety. Less than 2,000,000 sandlime bricks were manufactured in Manitoba in 1925.

The deeper clays of the Red river valley have not been used for brickmaking purposes. They are available in very large quantity, but their plasticity is too high for satisfactory results. By pre-heating, however, they can be made available, and if a sufficiently large industry were built up, this process might be economically possible.

COAL

Thin seams of lignite outcrop on the flanks of Turtle mountain, at an elevation up to 200 feet above the sandstone which shows immediately south of Boissevain. The seams vary in thickness up to 5½ feet, but average less than 3 feet in thickness. There have been no mining activities since 1908 in this district; but at an earlier date, from 1895 onwards, the McArthur mine was operated on Sec. 11, T. 2, Range 23 W., 6 miles S.S.E. of Deloraine. At a depth of approximately 40 feet two seams were worked respectively 2 feet and 1½ feet thick, separated by 2 feet of fire clay. Where the seams came together the coal was much more broken than in the separate seams. The mine was very wet, and there was difficulty in keeping the roof up. In 1908 the mine was reopened by two Welshmen, but operations were discontinued. On the west flank of the mountain, at Henderson's farm (Sec. 12, T. 1, Range 24 W.) the Varden mine was operated about the time that the McArthur mine was first in operation. Three seams were found, respectively 5½, 3½ and 1½ feet. More recently in that district there has been renewed interest in the possibilities of lignite development, owing to a seam of coal 3½ feet thick having been drilled at 8 feet below the surface in the bottom of a ravine 115 feet deep on Powne's farm (25-1-24 W.). An analysis by Milton Hersey Co. gave the following:

Moisture	11.16%
Sol. comb. matter	40.45
Fixed carbon	41.85
Ash	6.55
Sulphur	1.06
B.T.U.	10240

This is a higher grade of coal than the Souris lignite, but a considerable percentage of moisture may have been lost in transit.

Dowling estimates the total coal of the Turtle mountain area to be 160 million tons. It is doubtful, with the competition of the Estevan field, whether any large-scale operations could be contemplated on these thin seams. It is probable however that coal could be excavated for local use, particularly on the west slope of the mountain, at a saving to the farmers of the district.

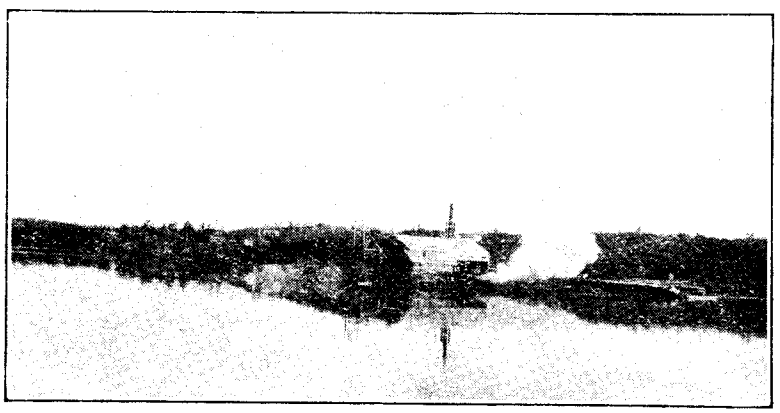
Coal has been reported probably in place on the Swan river slope of Duck mountain, Porcupine mountain, and on Swan river east of Bowsman. It has also been found in the drift in many parts of the province, but drift occurrences are of no economic value.

COBALT

Cobalt bloom (erythrite) has been found in quantity in one area in Manitoba—northwest of the northeast arm of Schist lake, where it has been oxidised from finely disseminated smaltite in the schists. The presence of cobalt bloom has led in those areas to prospecting for native silver, but in no area have calcite veins of the Cobalt type yet been found. The smaltite is disseminated in the northern area apparently as arsenopyrite or pyrite is in other districts, but not in economic quantity.

COPPER

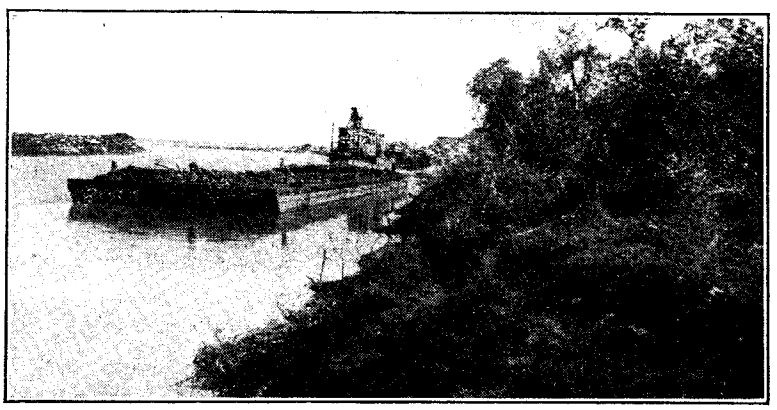
Interest was first aroused in the prospecting for copper in Manitoba when the large orebody of mixed sulphides at Flin Flon lake—stake din 1915 on a weathered gossan which panned



The Flin Flon property, Flin Flon lake

values in gold—was found to be primarily a copper sulphide deposit. The Flin Flon orebody remains the largest copper deposit yet found in Manitoba. By systematic diamond drilling a body of 16,000,000 tons has been blocked out to a depth of 900 feet, with an average value of 1.68% copper, 3.49% zinc, .074 ounces per ton gold, 1.04 ounces per ton silver. This orebody is situated eighty miles northwest of The Pas, on the boundary line between Saskatchewan and Manitoba. The nearest railway communication is at The Pas. Owing to the low price in copper from 1920 onwards until recently, this property has not yet been opened up for development. The capital investment in water power development, smelter, mine and railway would require to be very large, and the operations would be on a correspondingly large scale. Shortly after the discovery of the Flin Flon, and four miles southeast of that lake, there was discovered on the middle arm of Schist lake a lens of high-grade copper sulphide,

with an average value of 18% copper, .1 oz. gold, and 2.5 ozs. silver per ton, This was taken up by the Tonopah Mining Company and mined from 1917 to 1919, during which time 25,000 tons of ore, averaging in total recoverable value $91.00 per ton, were mined, hauled in winter by sleigh forty miles to Sturgeon landing, then in summer by barge 130 miles to The Pas, and thence by train to Trail to be smelted. There remains 180,000 tons of lower grade ore in this property, which will not be mined until a smelter is erected in that district. Very considerable prospecting and diamond drilling has been done in the Schist lake—Athapapuskow lake—Copper lake areas for copper, and more recently in Kississing (Cold) lake a body has been found which has good promise of ore. On the whole, most work has been done from the north arm of Athapapuskow lake northwards. These sulphide bodies are replacement deposits in shear zones



Transporting copper on Saskatchewan river

mainly in greenstone schist, consisting of pyrrhotite, pyrite, chalcopyrite, sphalerite, occasional galena, sometimes traces of nickel, and values in gold and silver. On the east arm of Athapapuskow lake, disseminated bornite and chalcopyrite occur in stringers and pockets in an epidotised greenstone, but no orebody has yet been proved up in that area.

Another copper sulphide area which has been prospected and diamond-drilled occurs on the Maskwa (Bear) river and eastwards to Oiseau (Bird) lake east of the south end of lake Winnipeg. Here the sulphides are of the Sudbury type, consisting of pyrrhotite and chalcopyrite and possibly pentlandite, as values in nickel occur. These sulphides are associated with gabbros and granites, and may represent a differentiate from a magma with which granite or gabbro, or both, were connected. Diamond drilling has also been done in this area, and on the Cup Anderson several hundred thousand tons of ore average 4% copper. The

Maskwa and Oiseau areas are very well placed in their relationship to the power development in the Winnipeg river and to railway communication, situated as they are within twenty miles of existing facilities.

Scattered copper sulphides are found in Oxford and God's lake areas, and native copper has been found in the amygdaloids north of lake St. Martin, under similar conditions to the native copper of northern Michigan, though only in minute particles.

DOLOMITE

Dolomite ($(Ca\ Mg)CO_3$ rock) and limestone of high magnesian content are characteristic of the Stonewall series in the Silurian system, and are exposed in quarries at Stonewall, Gunton, Inwood and Broad Valley, and in exposures at Grand Rapids and elsewhere in the Saskatchewan river valley. At Stonewall (Winnipeg Supply & Fuel Co. quarry) the stone is used for the manufacture of lime and as crushed stone and rubble. The other quarries are not now in operation. At Broad Valley an attempt was made to make use of a very fine grained, almost lithographic, dolomite for interior use as a decorative stone, but as yet without success. The Stonewall stone has been used locally as a building stone. The rough-finished stone in some handsome buildings in Stonewall is from local quarries. The lower quarry beds are sufficiently thick (2 ft.) for dimension stone, but are hard to work, and the quarry rock as a whole is not well adapted for building stone purposes. It burns to a very white lime, slow-setting owing to its high magnesia content, but setting hard. Apart from the market as a building material, it is shipped east to pulp mills whose process demands the magnesian lime, such as the Mettagami plant at Smooth Rock Falls. The crushed stone is used in part as a fluxing material for city foundries.

From the Gunton quarries, which are approximately of the same horizon as the Stonewall stone, the stone was shipped as crushed stone and rubble. No quarrying has been done since the war period, and very little in the last fifteen years. The overburden is thinner and the quarry beds deeper than at Stonewall.

Dolomites of Silurian age, similar to those at Gunton and Stonewall, occur 16 to 20 miles north and northeast of Arborg. These are found both in place and as drift material. Many of these limestones would be suitable for the manufacture of magnesian lime. Dolomitic limestones also occur on the Peguis Indian Reserve, north of Hodgson, and for several miles south of Hodgson.

No rock has been found approximating to magnesite in composition, though in some cases the percentage of magnesia is greater than that in dolomite. In higher magnesia dolomites

of this type it may yet be found possible to extract magnesia for refractory brick purposes by calcining and leaching off the lime with water.

The following is a typical analysis of the Stonewall dolomite:

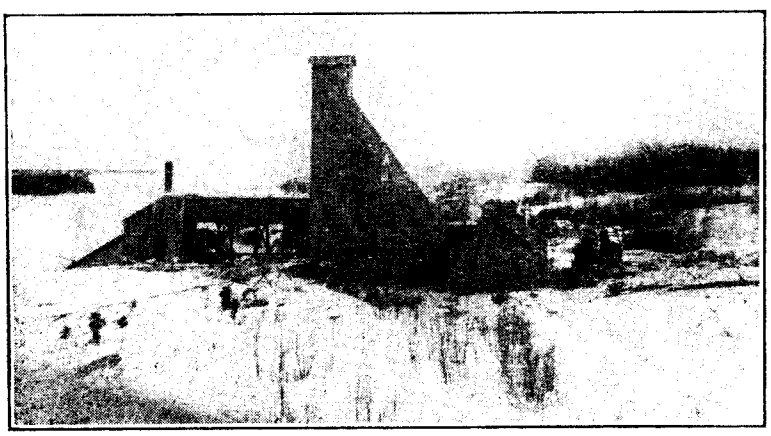
Moisture	0.11
Insoluble	0.30
Alumina and iron oxides	0.30
Lime carbonate	54.43
Magnesium carbonate	44.56
Sulphur trioxide	0.13

GARNET

Beautifully developed garnets in sizes up to 3 inches in diameter occur at the east end of Anderson lake, west of the Herb lake area, associated with staurolite and reddish cyanite. A considerable proportion of the crystals are of museum quality. Heavy bands of garnet rock are found south of the Winnipeg river, ten miles northeast of Point du Bois, in altered sediments. These bands occur in quantity sufficient to justify investigations from the standpoint of an abrasive material.

GOLD

The various areas in Precambrian territory in Manitoba where gold has been found are shown in Plate III. While isolated occurrences were known at an earlier date, the first systematic search began in 1907 in the area north of The Pas, now usually known as The Pas mineral belt, culminating in discoveries in (Wekusko) Herb lake in 1914 (the Kiski-Wekusko group). Discoveries were made on Rice lake, east of Lake Winnipeg about 1911 (the Gabrielle property), and in the Star lake country, west



The Rex property, Herb lake

The Luleo property, north of Hole river (as in 1923)

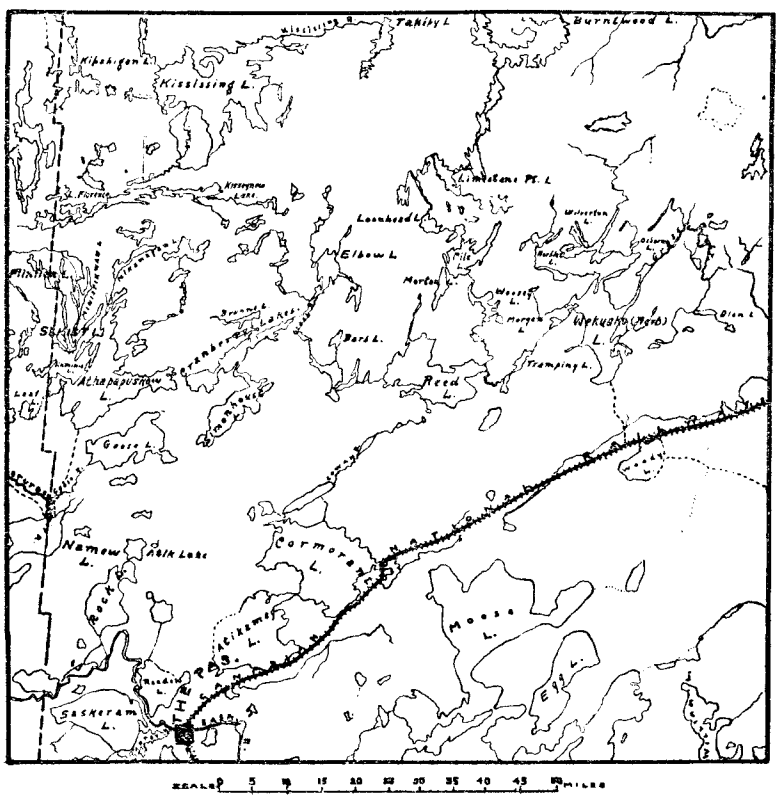


Plate IV. The Northern Mineral Area

of the Lake of the Woods area, somewhat earlier (the Penniac property). Since 1910 prospecting has been carried on fairly continuously in the areas of which the initial discoveries were the centres of activity, until today the areas have extended to embrace (I) the belt from Athapapuskow lake eastwards to Wintering lake; (II) the belt of the Wanipigon (Hole) and Manigotagan (Bad Throat) rivers eastwards to the Ontario boundary; (III) the West Hawk lake-Star lake-Falcon lake area between the Canadian Pacific Railway and the Greater Winnipeg Water District Railway immediately west of the boundary line. In these areas activity has centered mainly in (I) Wekusko (Herb) lake, Little Herb lake, Elbow lake and Copper lake; (II) Rice lake, Gold lake, Long lake, Bulldog lake, Hay lake and the Luleo district; (III) Star lake and Falcon lake. Some prospecting has also been done in other areas—Cross lake and Pipestone lake; Oxford lake and Knee lake; God's lake and Island lake. As these areas are far removed from railway facilities, only a limited amount of work has yet been done. Transportation difficulties have also very seriously hampered the prosecution of develop-

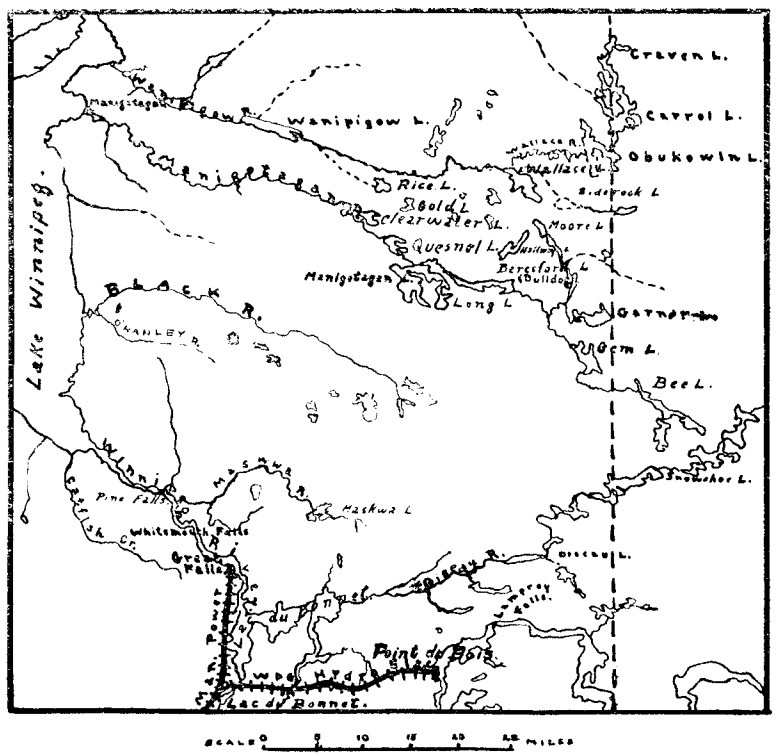
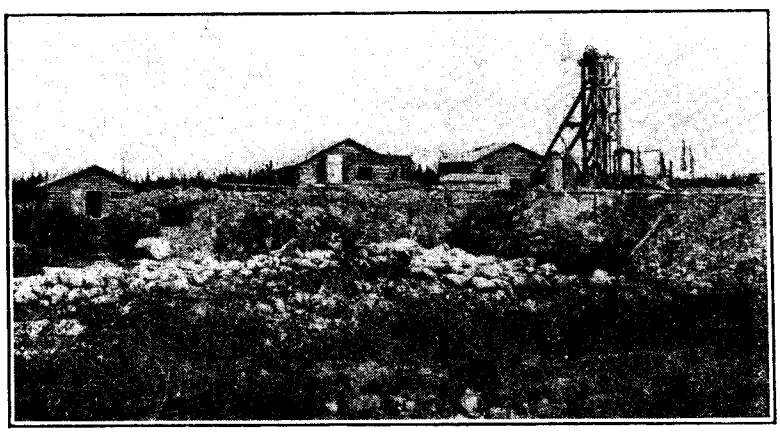


Plate V. The Eastern Mineral Area

ment work in the Manigotogan river area; though the recent development work in the Bulldog lake district is an instance of what can be done in spite of serious transportation disadvantages. The Elbow lake district in the northern area has also a difficult transportation problem to contend with. It is not always sufficiently well understood how serious are the difficulties that the pioneers in development in such areas have to face before they can obtain adequate transportation facilities.

The gold occurs either in fairly clear-cut veins, chiefly in rock invaded by the granite, such as greenstone or sediment, or in somewhat quartzose indefinite shear zones of mashed rock, in greenstone or sediment, or, not infrequently, in granite itself. No placer gold of economic importance has been found in the province. As a rule the gold occurs native, either separate in the quartz, or fine-grained in the pyrite and other sulphides.



The Kitchener property, Bulldog lake

Gold tellurides have, however, been found in several areas, most abundantly in shear zones north of Wanipigon (Hole) River lake, but nowhere forming any considerable percentage of the total gold values. The associated minerals are to a degree distinctive of the districts. Pyrite is an invariable associate of gold, but arsenopyrite is characteristic of the Wekusko (Herb) lake area, chalcopyrite of the Gold lake-Long lake area, and pyrrhotite of the Star lake area. Galena, sphalerite, tourmaline, felspar and on occasion stibnite occur in the vein matter associated with the gold in one or other of the districts.

The actual gold production in Manitoba has not been commensurate with the efforts put into development work during the last fifteen years. The only producing property at the present time (Sept., 1925) is the Rex mine (Wekusko lake), where the

production is incidental to development work. Mills have been in operation at the Luleo property (Wanipigow river), Gold Pan property (Gold lake), Penniac property (Star lake), and the Webb property (Elbow lake). Sinking to a depth of at least 200 feet and drifting on the veins for an equal distance has been done on six properties, while shafts have been sunk to 100 feet on fourteen gold properties in Manitoba. In some cases the values did not justify further development work; in some, capital was not available for prosecuting the work further, even although the values disclosed by underground work were encouraging. On the whole, the best opportunities lie in the large shear zones where the values may not be high, but where a large tonnage of rock of sufficient grade to be handled at a profit is more probable than in the narrow veins. Such shear zones occur not only in the sheared greenstone and sediment, but may run for some distance into granite as well.

The development work of greatest promise at the present time is in the Bulldog area of eastern Manitoba, where on the Kitchener property diamond drilling and sinking to 370 feet (Sept., 1925) has disclosed bodies of ore of greater size than have hitherto been blocked out in gold properties in Manitoba. Some good ore has also been found in the Oro Grande property. If the substantial companies which are prospecting these properties decide to proceed to milling operations, direct transportation and power facilities from the Winnipeg river would probably be obtained without delay.

GRANITE

The granite used for monumental purposes in Manitoba is imported from Quebec, New Brunswick, Minnesota, British Columbia, Western Ontario and Scotland. The only Manitoba granite that has been used for this purpose is situated on the Greater Winnipeg Water District line at Brookville, where a coarse-grained pegmatitic variety of reddish granite, with fine play of colour effects in the felspars, has been quarried and polished for monumental purposes. If material of reasonably uniform grain can be obtained in quantity an attractive stone will be available here though of larger grain than the ordinary monumental stone. No shipments have been made during the past year. In the quarry there is also a dark grey gneissose granite which it is proposed to quarry with the red pegmatitic variety.

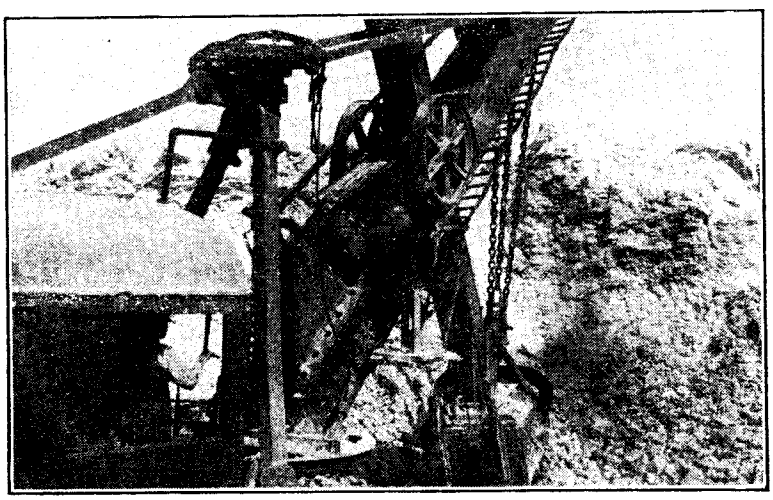
There is a very large variety of granite available to the railways which pass through Precambrian country in eastern and northern Manitoba, and to lake Winnipeg. Doubtless granite will be found in several localities sufficiently massive and attractive in grain and colour to satisfy the monumental market. The only granite yet quarried for structural purposes was from the east side of lake Winnipeg, opposite Bull head, where the Lake

Winnipeg Shipping Company took out stone in 1914-15 for rubble and foundation work.

The use of ice-carried boulders of granite and gneiss for building purposes is discussed under *Building Stone*.

GYPSUM

Gypsum beds outcrop northwest of the narrows of lake St. Martin, immediately north and northeast of Gypsumville. They have been operated continuously since 1900. Gypsum has been found by drilling at Leifur, St. Charles, Rathwell, St. Arnaud, St. Elizabeth and Dominion City at varying depths, underlaid by red clay. No attempt has been made to mine these deposits, the operations of the Manitoba Gypsum Co. at Gypsumville, where surface quarrying is possible, being sufficiently extensive for the present market in the prairie provinces.



The Steam shovel, Gypsum quarry, Gypsumville

In the early operations the gypsum was conveyed to Old Gypsumville on lake Manitoba by light railway, and there calcined, shipped by barge to Totogan at the south end of lake Manitoba, and thence by rail to Winnipeg. When the mill at Old Gypsumville was burned down in 1906, the raw gypsum was shipped by the same route to Winnipeg until the railway reached Gypsumville in 1910. The rock is now loaded on the cars by steam shovel, and shipped direct to the mills in west Winnipeg where the rock is calcined and manufactured into plaster-of-Paris, land plaster, semi-calcined plaster, hardwall (hair) plaster, wood-fibre plaster, asbestos plaster, plaster-board, partition blocks and various finishes. Uncalcined gypsum is used by the Canada

Cement Company as a retarder in cement manufacture. No gypsum is used as fertilizer in the western provinces.

The quarry beds on gypsum ridges which run in a northerly direction north of the town of Gypsumville, are of an average working depth of 10 feet in the present quarry, and somewhat more in the earlier workings. Gypsum would be available at considerable depth below the present workings, but only after a drainage system had been completed which would lower the water level by draining into lake St. Martin. The gypsum is mixed with anhydrite, the percentage of which increases with depth. The gypsum has formed, in part at least, from anhydrite, and the characteristic folding of the gypsum beds may have been caused by the increase of volume when anhydrite transforms into gypsum. Only limited quantities of anhydrite are admissible in the marketable rock. Southeast of Gypsum lake on Secs. 3 and 10, Tp. 33, Rge. 8W, a body of anhydrite was explored by core drills, and was found to have a depth of at least 100 feet. The stone when polished has a marble-like appearance, and might be of some value for interior decorative purposes.

The deposits in the Gypsumville area are extensive, covering four and a half square miles of surface exposure, and will be available for surface quarrying for several decades at the present rate of production. Except at Elephant hill, where fine masses of selenite occur, and a high-grade variety of gypsum has been quarried and hauled by sleigh in winter for plaster-of-Paris manufacture, only the ridges immediately north of Gypsumville have yet been developed. The annual production is now somewhat over 30,000 tons, though in the years of extensive building operations (1912-13) the production reached more than twice that figure; and from this deposit the market is supplied in the area from the head of the Great Lakes to British Columbia. The Pacific coast market will in future be supplied from a property operated by the Manitoba Gypsum Company at Falkland, southeast of Kamloops, B.C.

IRON

A deposit of hydrous iron oxide (turgite) occurs on the south shore of Black Island, Lake Winnipeg, in a highly tilted sericitic schist. The iron oxide is of the pisolitic variety, grouped in bunches and spheres in the schist, but also fine-grained, disseminated through the rock. Some exploratory work has been done on the deposit, which is of low grade and would require to be concentrated. Its total extent has not been determined.

Bands of "iron formation"—interbanded haematite or magnetite with jasper, slate and greywacke—such as are found in considerable bodies in western Ontario, are also found in eastern Manitoba on the upper Manigotagan river, north of Falcon lake, and on Knee lake. A reference to magnetite in one such band on the narrows at Knee lake by Edwards in 1812 is the earliest des-

cription of a metallic deposit in Manitoba. A fairly heavy body of magnetite north of Falcon lake, in the mineral territory south of Ingolf, lies in an "iron formation."

"Iron dykes"—replacement bodies of pyrrhotite and pyrite in mashed greenstone or sediment—are very characteristic of the northern Manitoba area and of the West Hawk lake country. They occur as well in Oxford lake and are probably to be found in all the mineralized Precambrian territory. In such bodies copper has been found in grade of economic importance, gold, silver and zinc, and small percentages of nickel. Iron would not be recovered from such bodies except as a by-product in very extensive operations. It is, however, the most uniformly distributed and abundant metal in these deposits.

Iron ochre, yellow and red—is found in beds in the Palaeozoic limestones in the Great Lakes area of Manitoba. It has been used by the Indians for painting houses and canoes. A fairly large bed has been found north of Moose lake.

KAOLIN

Thin beds of clay of kaolin quality overlie a blue clay at water level on Deer (Punk) island, lake Winnipeg. This is apparently a residual clay, formed by disintegration of the underlying rock, and has escaped glacial erosion. Its known extent is small, but the deposit is concealed in part by the water of the lake, and has not been fully prospected. The kaolin occurs in lenses in shales, which form part of the bottom of the Palaeozoic sediments in that area.

LEAD

Galena is found in gold-quartz veins and in sulphide replacement bodies, but not in quantity of importance from the point of view of the recovery of lead, though it may be responsible for certain values in silver in such occurrences. The galena-sphalerite deposit on Little Herb river, at the north end of Herb lake, where a flat-bedded sediment (quartzite) has been replaced to a depth of 15 feet, has a fairly heavy concentration of lead (with silver values), and may be found to be of marketable grade, when fully prospected. It is in part mixed with sphalerite and stibnite, and in part fairly well separated from other sulphides, one trench of 35 feet showing 30% zinc and 6% lead.

LIMESTONE

The Ordovician, Silurian and Devonian formations are made up mainly of limestone, and are exposed between lake Winnipeg and lakes Manitoba and Winnipegosis, and northwards to Cedar lake, Moose lake, and the Saskatchewan valley. They are exposed also in the Nelson and Hayes rivers, adjacent to the west shore of Hudson bay. In the main the limestones are high in magnesia, and in the Silurian formation are true dolomites (see

under *Dolomites*). The purest limestones occur in the Elm Point and Manitoba horizons of the Devonian rocks, and are exposed at Oak point, Steep rock and Elm point on lake Manitoba, Spearhill, east of Moosehorn, and at several points on the west side of lake Manitoba and lake Winnipegosis, the most accessible of which are at the mouth of Mossy river, lake Winnipegosis, Snake island and Steep rock, Dawson bay, eight miles northeast of Mafeking. The only places where development has taken place to date are the following: Oak Point, where D. Bowman Co. have developed a quarry for lime burning, and for exporting limestone to pulp companies; Steep Rock, where the Canada Cement Co. quarry and crushes limestone for shipment to their mill at Tuxedo, and Spearhill, where the Winnipeg Supply & Fuel Company burn lime and ship out some crushed stone for stucco work. The quarry at Oak Point is not at present in operation. From Steep Rock quarry sixty cars of crushed rock are shipped out every week, and from Spearhill four cars of lime, and one of crushed rock (July, 1925). The limestone is of similar character at those three quarries, and at the other exposures above referred to. A typical analysis is given under *Cement Rock*. It is very thin-bedded (2"-3" average thickness), and therefore of no use for building purposes. It has a very low magnesia content, and is, except in some clayey layers, a practically pure limestone. The darker varieties of this stone, which is usually mottled grey and brown, have probably a slightly higher magnesia content than the paler varieties. The further utilization of this rock when needed for lime, cement, or pulp manufacture, will be determined solely by the distance of outcrop from transportation facilities. The rock is available in large quantity.

The Ordovician limestones are the important building stone formation in Manitoba. They have been quarried for this purpose at Lower Fort Garry, Bishop's Quarry (St. Andrew's Locks), and East Selkirk; but quarrying operations are now confined to Garson (Tyndall), where three companies—the Western Stone Co., Oliver & Manson, and Gillis Ltd.—operate quarries with a combined output of eighteen cars per week (June, 1925). The stone, which belongs to the Upper Mottled Limestone horizon of the Ordovician system, is quarried in beds up to 3 feet thick, but normally from 2 to 2½ feet thick. The overburden at Garson varies from 4 to 10 feet in thickness. The rock has a strikingly mottled aspect, the darker patches being either buff or blue in colour, the buff being evidently an oxidation phase of the blue, and occurring in the upper 6 feet of the solid quarry rock, except along the jointing planes, when it extends to greater depths. The rock is quarried to a depth of 22 feet, exclusive of overburden, in the Western Stone Company's quarry, which is the deepest now in operation; the lowest tier of blue mottled stone contains considerable silica. The rock is sawn in Winnipeg and finds a market as a building stone, not only in the prairie provinces, but in

Ontario, Quebec and British Columbia. For details, see under *Building Stone*.

Ordovician limestones are found north of Arborg and near the mouth of the Fisher river. Some of the limestones near Arborg are very nearly pure, containing less than 3 percent of impurities in some cases.

The exposure which is quarried at Garson is at the east end of a ridge which extends westwards to East Selkirk. There are several exposures of the same horizon on the west side of lake Winnipeg north of the mouth of the Saskatchewan river. There are properties at Garson which can yet be developed when the demand increases for stone, and development would be possible in reach of easy transportation at other points. To date the buff variety has been more sought after than the blue, but fashion may change, and the deeper beds of the quarries be more in demand.

At Garson the broken stone unsuitable for building stone is burnt for lime; at present, owing to the limited demand for lime, no kilns are operating. The following is a typical analysis of the light and the dark parts of the mottled stone:

	Light Coloured	Dark Coloured
SiO_2	1.56	1.56
Total Iron as Fe_2O_3	0.16	1.94
(FeO	0.12	0.45)
Al_2O_3	0.06	2.27
$CaCO_3$	94.02	71.03
$MgCO_3$	4.33	23.35
	100.13	100.15

At Stony mountain the limestone is more clayey, and higher in magnesia than at Garson. It is quarried by the City of Winnipeg for crushed stone and rubble, with a shipment of ten cars per day (June, 1925). The crushed sizes are 1½", ½" and dust. The crushed stone is used by the city as a street material, and by the Canadian Pacific Railway for station work. Rubble is used for railway construction work. Crushed limestone will replace gravel for roadwork when economic conditions make it possible, as it binds better and gives a smoother surface. The working face at Stony mountain is 10½ feet deep.

Limestone rubble has also been quarried at the north end of Big (Hecla) island on lake Winnipeg by the Lake Winnipeg Shipping Co., and shipped to Winnipeg by barge. This quarry is not now in operation.

The exposures of Silurian age at Stonewall, Gunton, Inwood and Broad Valley are true dolomites, and are treated under that heading.

LITHIUM (Lepidolite and Spodumene)

Lithium-bearing minerals occur in an exposure of pegmatite in Sec. 16, Tp. 16, Rg. 16E, approximately nine miles northeast of Point du Bois, and one and a quarter miles south of the Winnipeg river. The important lithium-bearing minerals in this exposure are lepidolite and spodumene, with which are associated considerable felspar (orthoclase and albite) and quartz, and fibrous amphibole. The minerals show on the face of a hill, sloping westwards into a swamp, and in the area exposed (110'x40') almost half of the mineral is lithia-bearing. No work has yet been done to determine the depth of the deposit. A pole track is being constructed from the deposit to the Winnipeg river below Lamprey falls (three and a half miles), from which point to Point du Bois there is no fast water. It is purposed to ship a carload of selected ore to England for complete tests in a lithium refining plant. If

Lepidolite and Spodumene outcrop, east of Point du Bois, Winnipeg river

the deposit is found to continue in depth, a plant will probably be built near Point du Bois, where the City of Winnipeg has its power installation, to extract the lithium and any associated elements which may be of value. Lepidolite also occurs two miles farther east in the same granite area, though not, on surface showing in economic quantity. It has also been reported from the Star lake area, south of Ingolf.

MOLYBDENUM

Molybdenite (molybdenum sulphide) occurs in beautifully large crystal aggregates associated with pegmatite carrying scheelite in the Falcon lake district, south of Ingolf. As with the scheelite, some of the molybdenite was cobbed for shipment in 1918, but the drop of prices at the close of the war made further

shipment impossible. Some molybdenite was also taken out from a pegmatite on the west shore of Crowduck bay, Wekusko lake. It occurs in noticeable quantity in Phantom lake, in the Flin Flon district, and in many quartz veins in the gold areas in Manitoba. With it is usually found yellow encrustations of molybdenum ochre.

NICKEL

In the Maskwa (Bear) river district, northeast of Lac du Bonnet, nickel, probable in the form of pentlandite, occurs with chalcopyrite and pyrite in bodies in close association with gabbros and granite. The sulphides bear considerable resemblance to the Sudbury type, and their field relationship to the gabbro has suggested magmatic concentration as an explanation of the sulphides. More recently however a direct relationship to the granite has been argued. The percentage of nickel varies from very small quantities up to 4 per cent as far as diamond drilling operations have yet gone in the Maskwa river area.

Nickel has been found, but in very small amount, in several of the pyrrhotite "iron dykes" which are characteristic of the mineralization of northern Manitoba and West Hawk lake.

OIL AND GAS

Drilling for oil has been carried on at many points in Manitoba. In the main, the oil shales of Cretaceous age (Benton and Niobrara) from which oil may exude in surface exposures, have been responsible for the attempts to find oil at depth. These shales have been drilled south of Manitou, at Neepawa, Riding mountain, Vermilion river, Mafeking, and also on Old Man river in the Pasquia hills west of the Manitoba boundary line. The shales carry from 8 to 10 gallons of oil per ton, which is not sufficient for economic distillation, but might serve to supply a small reservoir if favorable geological structure could be found. The whole face of the Manitoba escarpment is very poorly capped, and the chances in favour of any such reservoir, if formed, having escaped must not be overlooked.

Drilling has also been carried on in the limestones of Palaeozoic age, southeast of Winnipegosis in a Devonian limestone dome, at Rabbit point on the east side of lake Manitoba, and at a point west of Stony mountain. On the dome at Winnipegosis, the structure would be favourable, if oil occurs in Palaeozoic rock. The drilling was continued to the granite without favourable results. West of Stony mountain the granite was reached, and penetrated for over 200 feet. The lower Palaeozoic limestones have been penetrated repeatedly to the granite in search of water, without any indication of oil being disclosed.

Pockets of gas have been found at several places, occasionally under considerable pressure. Few wells have been dug to any great depth, particularly in the Cretaceous shales, without encountering gas. The oil shales of Niobrara age are probably the main source of this gas, which has however frequently migrated to other horizons. At two places in Manitoba natural gas has found use for domestic lighting purposes. The one is the Waskada-Sourisford district, where gas is used in the dwelling houses for lighting, and has been tried for cooking and heating as well. This field is probably a northward extension of the Bottinean gas field of North Dakota. The gas is found at a depth of 210-240 feet, and at an average pressure of 14 lbs. The other locality is near Treherne, where Mr. Rannard has used gas for many years for lighting his farm dwelling.

OIL SHALE

Certain horizons in the Cretaceous shales which form the western escarpment of Manitoba are bituminous. This is particularly the case with the Niobrara shales, which are exposed in the Pembina river, Assiniboine river and the rivers which carve the Riding, Duck and Porcupine mountains. Such bituminous shales smell of oil in hot weather, burn in the fire, and show evidence of oil in nearby pools of water. They have been responsible for considerable search for oil by drilling (see *Oil and Gas*). Their oil content is 8-10 imperial gallons per ton, in the most favourable exposures, which is too low for successful extraction by distillation, even under favourable transportation conditions. Some specific occurrences of these shales are the following: Pembina river, south of Manitou, Ochre river, Vermilion river, Pine river, Sclater river, Favel river, as well as Old Man river in the Pasquia hills (Saskatchewan).

The origin of the bituminous material is not definitely established. It is, however, significant that there are found closely associated with the oil-bearing shales greyish shales (Niobrara) packed with tests of foraminifera, mainly Globigerina. The source of the hydrocarbon may well have been the softer parts of these protozoa.

PEAT

Peat beds are characteristic of many of the swamp areas in Precambrian territory in eastern and northern Manitoba, and are being augmented by a fairly rapid growth of vegetation. The most important beds yet surveyed lie in the valley of the Whitemouth river, and west of Point du Bois; but extensive beds occur north of the Winnipeg river, northwest of Lac du Bonnet, also north of the Saskatchewan river on the northwest end of lake Winnipeg. An approximate total area of 242,000 acres of peat and litter bog has been surveyed in Manitoba, the most extensive being the bog east of Whitemouth, of which the investigated area

is 97,000 acres, and the depth 11 to 12 feet. A plant was in operation southwest of Lac du Bonnet, west of the railway tract in 1907, but has been closed since that date. With the possible exception of the bogs immediately west of Point du Bois, the agricultural possibilities of these marshes are better when drained than are the fuel possibilities under present conditions, as the vegetation is not yet sufficiently humified for utilization in the peat industry.

POTASH

In the early analyses of the brines from the west side of Dawson bay, lake Winnipegosis, reported in 1889-90, percentages of potassium chloride in the total solids of from 4% to 5.2% were given from several springs. On that basis the brines would offer some likelihood of successful extraction of potash. It has been found, however, on a careful examination of all the important springs that these figures are in error, and that the potassium chloride varies from 0.03% to 1.20% of total solids. This is too low for the extraction of potash.

The lithium-bearing minerals south of the Winnipeg river, east of Point du Bois, contain considerable percentages of potassium. If a lithium extraction industry develops in connection with this deposit, potash may be obtained as a by-product.

SALT

Salt springs occur in Manitoba from the Pasquia hills to the international boundary line at Emerson, issuing intermittently over an area approximately two hundred miles long by thirty miles wide. Eighty-four separate groups of springs have been measured with a total volume of 430 gallons per minute, representing approximately 52,500 tons of salts reaching the surface every year. Of the salts, 85 per cent is sodium chloride. The concentrations of the brines is too low to permit of successful development under present conditions. The average percentage of solids in the brines on the west and south side of Dawson bay (lake Winnipegosis), where the brines are strongest, is only 6%, and the brines in southern Manitoba are still weaker. The strongest brine thus far obtained is from a well at Neepawa, 1800 feet deep, where at 1185 feet and again at about 1600 feet, strong brines were obtained, with an average percentage of total solids of 19.08, of which 94.88% was sodium chloride. The water stands at 285 feet below the surface. Early in May of this year (1925) an attempt was made to test the concentration and volume of the brine by continuous pumping, but mechanical difficulties made the test inconclusive. It is planned to test this well by pumping continuously for several days. Definite evidence has not been found that the salt in this well, and from the springs which are most numerous

on the west side of Swan lake and lake Winnipegosis, are derived from the leaching of solid salt beds. The salt in the springs is more probably derived from isolated salt crystals in the Winnipegosan horizon of the Devonian limestones. The strong brine flows on the Neepawa well are from Silurian and Ordovician horizons.

On the salt springs was based the first mineral industry in western Canada. From 1800 to 1876 and probably at a still earlier date, freedmen from the Hudson's Bay Company service, and in the early years employees of the North-West Company, evaporated the brines from the springs west of lake Winnipegosis and lake Manitoba in iron kettles or troughs, and supplied to all the Hudson's Bay Company posts from Norway House to Fort Qu'Appelle, and to the Red River Settlement as well. In the years prior to 1874 more than 1000 bushels were manufactured annually at Monkman's springs. The product was reddish in colour and deliquescent, but met the needs of the district until the railway brought in the salt from Ontario. In 1894 an attempt was made to revive the industry by the Northern Salt Works near Winnipegosis, but the plant operated for only two years. Any future production can only come from the more concentrated brines of the deeper horizons, such as is tapped by the Neepawa well.

A brine from the Winnipeg sandstone horizon, tapped at the Elmwood Sanatorium on the east bank of the Red river, is said to possess curative properties in the case of muscular ailments. It is also carbonated and used as a beverage.

SAND AND GRAVEL

Sand and gravel deposits are very plentifully distributed over all parts of Manitoba. They occur as beaches of ancient glacial lakes, as fluvio-glacial eskers, and as outwash fans, all formed when the ice-sheet of Pleistocene times melted northwards. In the beaches (grouped principally along the Manitoba escarpment) there is a certain uniformity of texture, but in fluvioglacial material such as is found in ridges and irregular masses east of the Red river, sand and gravel succeed each other in sharpest contrast. The pebbles of the gravel beds are mainly granite and limestone, the percentage of limestone increasing with the distance from the eastern boundary of the province. In places (as at Birds' Hill) the pebbles are sufficiently massive to provide material for a crushed stone industry.

The sand ridge at Beausejour supplied the sand for some years for a bottle-glass industry. After the plant was shut down in 1913, sand was shipped to the glass factory at Redcliff, Alberta. The possibilities of the soft sandstone on Elk island and Black island as a raw material for a glass industry are referred to under *Sandstone*. Moulding sands are obtainable at St. Rose du Lac, Melbourne, and at Bird's Hill, and are available along the Win-

nipeg Water District line. Sand for the sand lime brick industry has been got near Milner, at Marchand, at Beausejour, and at Brandon. For mortar, and for cement tile, sand is got in the Bird's Hill ridge and at Marchand.

With increasing attention being paid to road construction, the demand for gravel has grown rapidly. There are many gravel pits distributed throughout Manitoba. The most extensive operations for the Winnipeg market are south of Woodlands and along the Birds' Hill ridge. The long beach ridges extending from the Pembina hills to the Porcupine mountain have been tapped at several points for local use. Few roads in Manitoba have yet been gravelled for more than sixty miles on a continuous stretch. When the practice of road gravelling becomes general very few municipalities will be seriously inconvenienced for lack of sufficient gravel beds within their bounds.

SANDSTONE

There are three sandstone horizons in the province—the Winnipeg sandstone, exposed at Elk island, Black island, Deer island and Punk island on lake Winnipeg; the Dakota sandstone, showing at the south end of Swan lake, and on Red Deer river; and the Fox Hill sandstone south of Boissevain. This last sandstone has found a local use in Boissevain as a building material, and is discussed under *Building Stone*. The Dakota sandstone is very friable, not easily accessible, and of no immediate economic value. The Winnipeg sandstone on Elk island and on Black island is a loosely consolidated sand of remarkable purity, and might well supply the silica for a glass industry, if such were established in Manitoba. It is readily available for lake transportation, and except in its lowest beds, is not stained with iron. The most available exposures are on the south shore of Black island, east of the iron deposits. The following is an analysis of sandstone from Punk island, where quarrying operations were at one time carried on:

Silica	96.34
Lime	.89
Magnesia	.13
Ferric oxide	1.51
Ferrous oxide	.12
Carbonic acid	.45
	99.44

The cliff at this point is 26 feet high, 21 feet of which is sandstone. Lenses of still purer material occur in the section.

SILVER

Native silver in the associations found at Cobalt, South Lorrain, and Gowganda, has not been discovered in Manitoba, though there have been several "still" hunts for reported finds of

this type of ore. The Nipissing diabase, from which the silver deposits have been derived in Ontario, have been found in Manitoba to date only in small dykes, which do not seem to carry silver. Silver occurs, however, probably in the form of argentite, in several of the sulphide replacement bodies throughout northern Manitoba, and in small values in some of the gold veins in all the mining areas. In the Mandy orebody the silver values in the mined ore were 2.5 oz. per ton, with a total recovered value of $58,000. In the unmined ore there are also good silver values. In the Flin Flon orebody, the average silver values for 16,000,000 tons are 1.04 oz. per ton. In several of the large pyrrhotite "iron dykes" values in silver are found. In the galena-sphalerite replacement body in quartzite on Little Herb river, values in silver were obtained representing in ounces approximately the same figure as the percentage of lead in the sulphide body. Silver has not been mined except as a by-product in the high copper sulphide lens at the Mandy mine.

TUNGSTEN

Scheelite (lime tungstate) is found in quantities which, during war-time prices, were of economic grade, associated with pegmatites in the Falcon lake area south of Ingolf. Several tons were quarried, cobbed and sacked for shipment in 1918, but with the conclusion of hostilities the price dropped and the scheelite was not marketed. Associated with the scheelite is considerable molybdenite. Scheelite is also found in gold-bearing pegmatites on the west side of the north arm of Little Herb lake, but in smaller quantity than at Falcon lake. Wolframite and huebnerite have not been recorded in Manitoba.

ZINC

Sulphide of zinc (sphalerite) occurs in several of the sulphide replacement bodies in the Schist lake, Athapapuskow lake, Copper lake areas in Northern Manitoba. In the Mandy mine the lens which was excavated contained sphalerite in places in very considerable concentration, and much sphalerite remains in the unmined ore. In the Flin Flon ore there is 3.49% zinc, which may be recovered when the deposit is mined. From the Mandy orebody the zinc was not recovered. As a rule in the replacement bodies, the sphalerite is intimately mixed with pyrrhotite, pyrite and chalcopyrite. At the north end of Herb lake, however, on the Little Herb river, sphalerite and galena occur in flat-bedded sediments, having replaced quartzite in a bed which was bottomed at a depth of 15 feet. This shows probably the highest grade of zinc sulphide in the province, the largest trench running 30% zinc. Zinc in considerable concentration (sphalerite) is also found on the east and west sides of Kississing (Cold) lake. No mining of zinc ore has yet been done.

Mineral Production of Manitoba, 1914-1924

(Figures Supplied by Dominion Bureau of Statistics, Ottawa)

Product	Unit	1914		1915		1916		1917		1918		1919	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
			$		$		$		$		$		$
Copper	Lb.							1,116,000	303,329	2,339,751	576,234	3,348,000	625,775
Gold	Oz.							440	9,095	6,755	139,638	724	14,966
Silver	Oz.							7,201	5,863	13,316	12,886	20,760	23,069
Tungsten Concentrates	Lb.									177	42		
Calcined Gypsum	Tons	53,423	382,563	20,278	139,721	28,489	191,283	33,347	258,934	37,483	341,352	32,903	371,337
Clay Products			317,488		93,674		104,248		114,651		116,417		131,737
Lime	Bus	526,167	92,898	281,432	71,372	355,301	83,754	393,982	92,932	462,544	134,725	476,452	147,131
Cement	Bls	402,131	737,046	339,554	625,369	427,293	794,897	544,949	1,175,669	500,302	1,283,948		
Sand-lime Brick	No	19,200,809	207,501	2,775,420	31,121	3,215,097	33,048	5,070,500	76,742	5,395,423	82,438	7,389,300	124,847
Stone			361,912		153,464		372,894		301,968		238,251		89,067
Natural Gas	M cu. ft.												
Sand and Gravel	Tons												
*Other Products			314,081		203,666		243,452		289,081		294,493		1,340,449
Total			2,413,489		1,318,387		1,823,576		2,628,264		3,220,424		2,868,378

*For 1921, 1922, 1923 includes cement, and sand and gravel.

Mineral Production of Manitoba, 1914-1924—Continued

(Figures Supplied by Dominion Bureau of Statistics, Ottawa)

Product	Unit	1920		1921		1922		1923		1924	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
			$		$		$		$		$
Copper	Lb.	3,062,577	534,604								
Gold	Oz.	781	16,145	207	4,279	156	3,225	31	641	1,180	24,393
Silver	Oz.	15,510	15,649	33	20	20	14	5	3	140	93
Tungsten Concentrates	Lb.										
Calcined Gypsum	Tons	44,371	487,894	40,859	480,282	34,072	440,914	31,575	386,554	29,375	348,212
Clay Products			206,764		208,982		210,740		160,134		117,450
Lime	Bus.	605,399	210,984	413,283	136,375	525,184	163,799	524,128	161,226	394,229	121,518
Cement	Bls									286,948	746,750
Sand-lime Brick	No.	10,278,802	197,734								
Stone	Tons		374,286	16,868	56,666	34,359	106,638	51,304	118,277	54,065	93,876
Natural Gas	M. cu. ft.	200	60	200	60	200	60	200	60	200	60
Sand and Gravel	Tons									359,535	81,897
*Other Products			2,179,341		1,047,453		1,333,552		941,142		
Total			4,223,461		1,934,117		2,258,942		1,768,037		1,534,249

*For 1921, 1922, 1923 includes cement, and sand and gravel.

BIBLIOGRAPHY OF ECONOMIC MINERALS IN MANITOBA

Amber

Amber, Coal, Gypsum, Division of Mineral Statistics and Mines (Part S, pages 6-201, Annual Report for 1890, G.S.C.), by E. D. Ingall.

Report on Northwestern Manitoba, with portions of the adjacent districts of Assiniboia and Saskatchewan (Part E, pages 5-231, Annual Report, 1890-91), by J. B. Tyrrell.

Arsenic

Mining and Mineral Prospects in Northern Manitoba (Northern Manitoba Bulletins, office of the Commissioner of Northern Manitoba, 1919, 47 pages), by R. C. Wallace.

The Reed-Wekusko Map Area, Northern Manitoba (Can. Dept. Mines, Geological Survey, Mem. 119, 1922), by F. J. Alcock.

Cement Rock

Preliminary Report on the Raw Materials, Manufacture and Uses of Hydraulic Cements in Manitoba (Mines Branch, Dept. of Interior, 1905), by J. Walter Wells.

Clays—(The Brick Industry)

Western Prairie Soils, Their Nature and Composition (Dept. of Agric., Ottawa, 1910), by F. T. Shutt.

Clay and Shale Deposits of the Western Provinces (Memoir No. 66, part V, 1912, G.S.C.), by Joseph Keele.

Preliminary Report on the Clay and Shale Deposits of the Western Provinces (Memoir No. 24, G.S.C.), by H. Ries and J. Keele.

Report on the Clay and Shale Deposits of the Western Provinces (Memoir No. 25, 1914, G.S.C.), by H. Ries and J. Keele.

Clays of the Lake Agassiz Basin (Trans. of the Royal Soc. of Can. XVIII, Sect. IV, 1924, pages 9-30), by R. C. Wallace and J. S. Maynard.

Coal

Amber, Coal, Gypsum, Division of Mineral Statistics and Mines (Part S, pages 6-201, Annual Report for 1890, G.S.C.), by E. D. Ingall.

The Coal Fields of Manitoba, Saskatchewan, Alberta and Eastern British Columbia, (G.S.C. Memoir 53, No. 1363, 1914, 142 pages), by D. B. Dowling.

Peat, Lignite and Coal (Mines Branch, Dept. of Mines, Ottawa, 1914), by B. F. Haanel.

Cobalt

Rice Lake Map Area, Southeastern Manitoba (pages 45-88, Summary Report, G.S.C., 1922, Part C), by J. F. Wright.

Mining and Mineral Prospects of Northern Manitoba Northern Manitoba Bulletins, office of the Commissioner of Northern Manitoba, 1919, 47 pages), by R. C. Wallace.

Copper

Amisk-Athapapuskow Lake District (Canada, Dept. Mines, Geol. Survey Memoir 105, 91 pages, 1918), by E. L. Bruce.

Chalcopyrite Deposits in Northern Manitoba (Economic Geology, Vol. XV, No. 5, July-August, 1920, pages 386-397), by E. L. Bruce.

Geology and Mineral Resources of Rice Lake and Oiseau River Area, Manitoba (Summary Report, 1921, Part C, G.S.C., 36 pages), by H. C. Cooke.

The Flin Flon Ore-body (Bulletin of the Can. Inst. of Min. and Met., 1920), by R. C. Wallace.

Mineral Deposits in Southeastern Manitoba (Rice Lake, Maskwa, and Boundary Districts), Manitoba Government Bulletin, 1921), by J. S. DeLury.

Flin Flon Map Area, Manitoba and Saskatchewan (Pages 1-36, Summary Report, 1922, Part C, G.S.C.), by F. J. Alcock.

Oiseau and Maskwa River Copper and Copper-nickel Deposits Southeastern Manitoba, by J. F. Wright (Bulletin of the Can. Inst. Min. and Met. No. 155, March, 1925, pages 220-231), by J. F. Wright.

Dolomite

Preliminary Report on the Limestones and the Lime Industry of Manitoba (Mines Branch, Dept. of Mines, Ottawa, 1905), by J. W. Wells.

The Silurian and Devonian Section of Western Manitoba (XXI, Summary Report of the Geological Survey, Department of Mines, for the calendar year 1912, pages 247-258), by E. M. Kindle.

Pseudobrecciation in Ordovician Limestones in Manitoba (The Journal of Geology, Vol. XXI, No. 5, July-August, 1913, pages 402-421), by R. C. Wallace.

A Contribution to the Study of Dolomitization (Trans. of the Royal Society of Canada, 1913, Vol. VII, pages 139-149), by R. C. Wallace.

Gold

The Rice Lake Gold District in Manitoba (Trans. of the Can. Inst. Min. and Met. Vol. XVI, 1913, pages 538-544), by R. C. Wallace.

A New Gold Area in Northeastern Saskatchewan and Manitoba (Can. Min. Inst. Trans. Vol. VIII, pages 174-181, 1915), by E. L. Bruce.

Gold-Bearing Districts of Southeastern Manitoba (G.S.C. Summary Report, 1916, pages 169-174), by J. A. Dresser.

The Manigotagan Gold District, Manitoba (Can. Min. Journ., Vol. XXX, Aug. 1st, 1916, pages 362-364), by J. S. DeLury.

Gold Quartz Veins and Scheelite Deposits in Southeastern Manitoba (Pages 11-15, Summary Report, 1918, Part D, G..S.C.), by E. L. Bruce.

The Reed-Wekusko Map Area, Northern Manitoba (Can. Dept. Mines, Geol. Survey Memoir 119, 1920, 47 pages), by F. J. Alcock.

Mining and Mineral Prospects in Northern Manitoba (Northern Manitoba Bulletin, office of the Commissioner of Northern Manitoba, 1919), by R. C. Wallace.

Mineral Deposits in Southeastern Manitoba (Rice lake, Maskwa river, and Boundary Districts, Manitoba Government Bulletin, 1921), by J. S. DeLury.

Rice Lake Map Area, Southeastern Manitoba (Pages 45-88, Summary Report, 1922, Part C, G.S.C.), by J. F. Wright.

Geology and Ore Deposits of Elbow Lake Area, Northern Manitoba (Pages 37-44, Summary Report, 1922, Part C, G.S.C.), by P. Armstrong.

Granite

Building Stones of Canada (Vol. IV, 1916, 333 pages, Mines Branch, Dept. Mines), by W. A. Parks.

Gypsum

Gypsum Deposits in Northern Manitoba (Can. Rec. of Science, Vol. III, April, 1889, pages 353-360), by J. B. Tyrrell.

Annual Report for 1901, Section of Mines (Gypsum) (Part S, pages 53-57, Annual Report—new series—Volume XIC, 1901, G.S.C.), by E. D. Ingall.

Gypsum and Salt in Manitoba (XVII, pages 165 to 169, Summary Report of the Geological Survey, Department of Mines, for the calendar year 1913), by A. MacLean and R. C. Wallace.

Gypsum and Brines in Manitoba (Geol. Surv. of Canada, Report for 1914, 8 pages), by R. C. Wallace.

Gypsum and Anhydrite in Genetic Relationship (Geol. Mag., Decade VI, Vol. I, June, 1914, pages 271-276), by R. C. Wallace.

Gypsum in Canada, Its Occurrence, Exploitation and Technology (No. 245, Canada Department of Mines, Mines Branch, 256 pages), by L. H. Cole.

Iron

Report on Explorations on Churchill and Nelson Rivers, and Around God's and Island Lakes (Part C, Report of Progress, 1878-79, pages 1-72), by R. Bell.

Report on the Geology of the West Shore and Islands of Lake Winnipeg (Part F, Annual Report, 1898, G.C.S., pages1-100), by D. B. Dowling.

Some Canadian Occurrences of Pyritic Deposits in Metamorphic Rocks (Economic Geology, Vol. XV, No. 7, 1920, pages 547-609), by G. Hanson.

Kaolin

Rice Lake Map Area, Southeastern Manitoba (G.S.C., Summary Report, 1922, Part C, pages 45-88), by J. F. Wright.

Lead

The Flin Flon Map Area, Manitoba and Saskatchewan (Pages 1-36, Summary Report, 1922, Part C, G.S.C.), by F. J. Alcock.

Limestone

Report on Northwestern Manitoba, with Portions of the Adjacent Districts of Assiniboia and Saskatchewan (Part E, pages 5-231, Annual Report, 1890-91), J. B. Tyrrell.

Report on the Geology of the West Shore and Islands of Lake Winnipeg (Part F, Annual Report, 1898, G.S.C., pages 1-100), by D. B. Dowling.

Preliminary Report on Limestones and the Lime Industry of Manitoba (Can. Dept. Mines, Mines Branch, Report No. 7, 1905), by J. W. Wells.

Building Stones of Canada (Vol. IV, 1916, 333 pages, Mines Branch, Dept. Mines), by W. A. Parks.

Molybdenum

Molybdenite near Falcon Lake, Manitoba (Pages 22-25, Summary Report, 1917, Part D, G.S.C.), by E. L. Bruce.

Molybdenite at Falcon Lake, Manitoba (Can. Min. Journ., Vol. XXXVIII, No. 23, December 1917, pages 460-462), by J. S. DeLury.

Mineral Deposits in Southeastern Manitoba (Rice Lake, Maskwa River, and Boundary Districts, Manitoba Government Bulletin, 1921), by J. S. DeLury.

Nickel

The Maskwa River Copper-Nickel Deposit, Southeastern Manitoba (Pages 19-29, Summary Report, 1920, Part C, G.S.C.), by W. S. McCann.

Geology and Mineral Resources of Rice Lake and Oiseau River Areas, Manitoba (Summary Report, 1921, Part C, G.S.C., 36 pages), by H. C. Cooke.

Oiseau and Maskwa Copper and Copper-Nickel Deposits, Southeastern Manitoba (Bulletin Can. Inst. Min. and Met. No. 155, March 1925, pages 220-231), by J. F. Wright.

Oil and Gas

Pasquia Hills and Lower Carrot River Region (VII, Summary Report of the Department of Mines, Geol. Surv. Branch, 1907), by W. McInnes.

Oil and Gas Prospects of the Northwest Provinces of Canada (Memoir No. 29, 1913, G.S.C.), by W. Malcolm.

Cretaceous Shales of Manitoba and Saskatchewan—Their Economic Value as a Possible Source of Crude Petroleum (Mines Branch, Dept. Mines, Can. Mem. Series, Dec. 1921, No. 3), by S. C. Ells.

Oil Shale

Pasquia Hills and Lower Carrot River Region (VII, Summary Report of the Dept. Mines, Geol. Survey Branch, 1907), by W. McInnes.

Pembina Mountains, Manitoba, (XVIII, pages 131-133, Summary Report, Geol. Survey of Can., 1915), by A. MacLean.

Cretaceous Shales of Manitoba and Saskatchewan—Their Economic Value as a Possible Source of Crude Petroleum (Mines Branch, Dept. Mines, Can. Mem. Series, Dec. 1921, No. 3), by S. C. Ells.

Peat

Investigations of the Peat Bogs and Peat Industry in Canada (No. 151, 1910-11, Mines Branch, Dept. Mines), by A. Anrep.

Peat, Lignite and Coal (Mines Branch, Department of Mines, Ottawa, 1914), by B. F. Haanel.

Salt

Gypsum and Brines in Manitoba (XIX, Summary Report, G.S.C., Dept. of Mines, 1914, pages 73-80), by R. C. Wallace.

The Salt Industry in Western Canada (Mississippi Valley Historical Association, Vol. VII, 1914, pages 271-276), by R. C. Wallace.

The Salt Deposits of Canada, and the Salt Industry (Mines Branch, Department of Mines, Ottawa, 1915), by L. H. Cole.

Sand and Gravel

Post-Tertiary Deposits of Manitoba and the Adjoining Territories of Northwestern Canada (Bull. of the Geol. Soc. of America, Vol. I, 1890, pages 395-410), by J. B. Tyrrell.

The Glacial Lake Agassiz (Monograph XXV, United States Geological Survey, 1895), by W. Upham.

Birds' Hill, an Esker near Winnipeg, Manitoba (Bull. of the Geol. Soc. of America, Vol. 21, pages 407-432, pl. 31, pub. July 20th, 1910), by W. Upham.

Sandstone

Report on Northwestern Manitoba, with Portions of the Adjacent Districts of Assiniboia and Saskatchewan (Part E, pages 5-231, Annual Report, 1890-91), J. B. Tyrrell.

Report on the Geology of the West Shore and Islands of Lake Winnipeg (Part F, Annual Report, 1898, G.S.C., pages 1-100), by D. B. Dowling.

Notes to Accompany a Contoured Plan of the Lower Slope of Turtle Mountain, Manitoba (XI, Part C, Summary Report of the Geological Survey Dept. of Canada for the calendar year 1902, pages 193-203), by D. B. Dowling.

Silver

Amisk-Athapapuskow Lake District, Manitoba (Canada Dept. of Mines Geological Survey, Memoir 105, 91 pages, 7 plates, 4 figures, 1 map, 1918), by E. L. Bruce.

Mining and Mineral Prospects in Northern Manitoba (Northern Manitoba Bulletin, office of the Commissioner of Northern Manitoba, 1919, 47 pages), by R. C. Wallace.

Sulphide Deposits of Flin Flon and Schist Lakes, Manitoba. (Can. Min. Journ., Vol. XXXVII, page 468), by R. C. Wallace.

Oiseau and Maskwa Copper and Copper-Nickel Deposits, Southeastern Manitoba (Bulletin of the Canadian Institute of Mining and Metallurgy, No. 155, March 1925, pages 220-231), by J. F. Wright.

Tungsten

Bulletin on Molybdenum and Tungsten—Mineral Resources of Canada (Mineral Resources Bulletin, Ottawa, 1904, G.S.C.), by R. A. A. Johnson, with notes (on Molybdenite) by C. W. Willimott.

Tungsten Ore Deposits near Falcon Lake, Manitoba (Can. Min. Journ. Vol. XXIX, No. 11, June 1918, pages 460-462), by J. S. DeLury.

Mineral Deposits in Southeastern Manitoba (Rice Lake, Maskwa River, and Boundary Districts) (Manitoba Government Bulletin, 1921), by J. S. DeLury.

Zinc

Amisk-Athapapuskow Lake District, Manitoba (Canada Dept. of Mines, Geol. Survey, Memoir 105, 91 pages, 7 pls., 4 figs., 1 map, 1918), by E. L. Bruce.

Mining and Mineral Prospects in Northern Manitoba (Northern Manitoba Bulletins, office of the Commissioner of Northern Manitoba, 1919, 47 pages), by R. C. Wallace.

Chalcopyrite Deposits in Northern Manitoba (Economic Geology, Vol. XV, No. 5, July-August, 1920, pages 386-397), by E. L. Bruce.

The Flin Flon Map Area, Manitoba and Saskatchewan (Pages 1-36, Summary Report, 1922, Part C, G.S.C.), by F. J. Alcock.

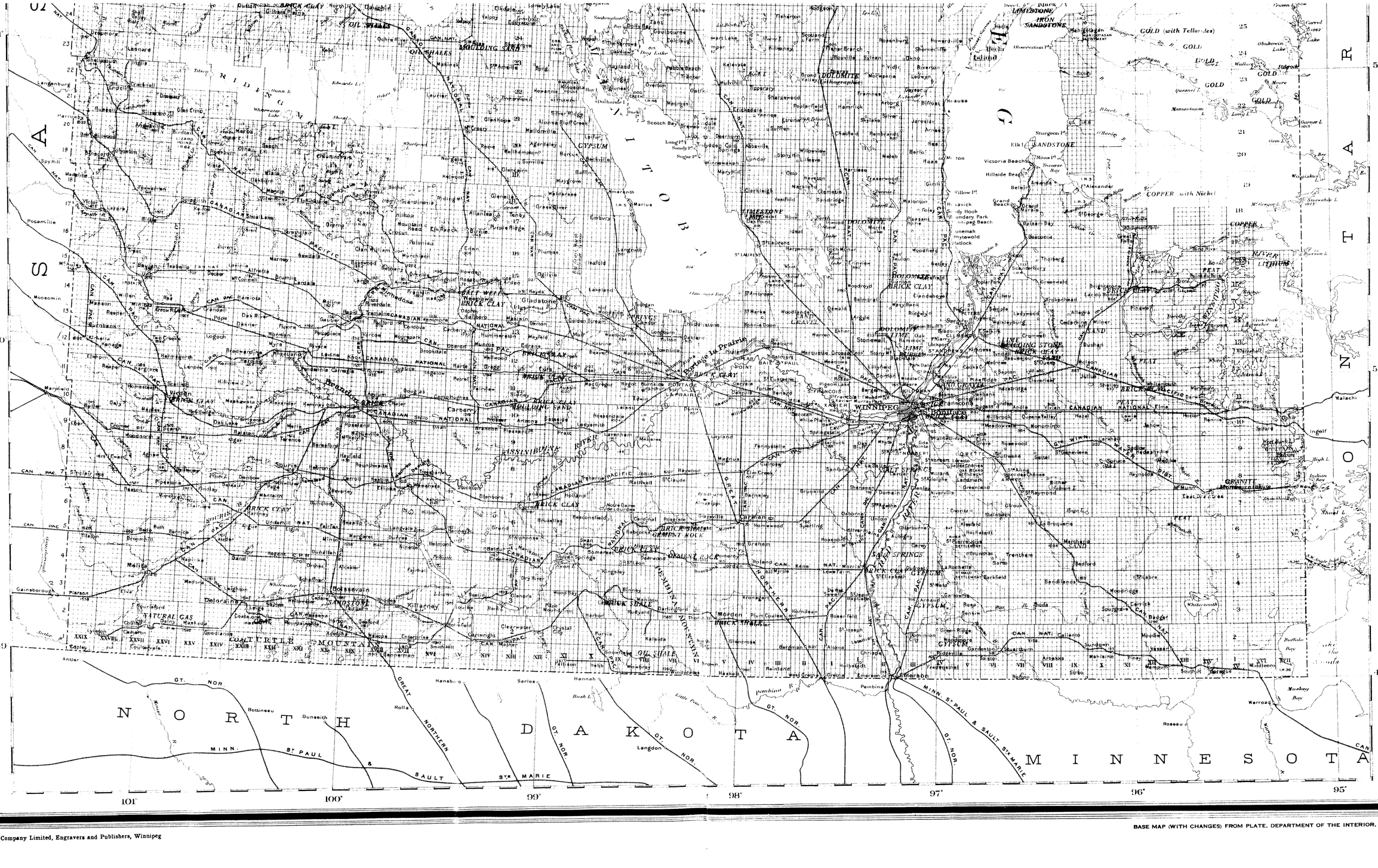
Printing by Saults & Pollard Ltd.
Plates by British & Colonial Press, Ltd.
Map by Stovel Co., Ltd.
Winnipeg

MAP OF
MANITOBA
CANADA
SHOWING MINERAL OCCURRENCES
Map Published by the Department of Agriculture and Immigration, Province of Manitoba.
Mineral occurrences compiled by Industrial Development Board of Manitoba.
1925
SCALE 12½ MILES TO ONE INCH
Miles
102°
101°
100°
99°
98°
97°
96°
95°
55°
54°
53°
COPPER ZINC
COPPER
GOLD TUNGSTEN
MOLYBDENUM
GOLD LEAD ZINC
ARSENIC SILVER
GARNET
GOLD ARSENIC
GOLD
COBALT
Kississing Lake
Burntwood Lake
Athapapuskow
Cormorant Lake
Cumberland Lake
Saskeram Lake
The Pas
Moose Lake
Cedar Lake
Grand Rapids
Cross Lake
Pipestone Lake
Norway House
Split Lake
Landing Lake
Sipiwesk Lake
Playgreen L.
Long Point
NELSON
SASKATCHEWAN
MANITOBA

NOTE

Position of mineral occurrence at first letter of word


1925
SCALE 12½ MILES TO ONE INCH
Miles
53°
52°
51°
S A S K A T C
O N T A R I O
L A K E W I N N I P E G O S I S
L A K E W I N N I P E G
L A K E M A N I T O B A
PRINCIPAL MERIDIAN
PORCUPINE MOUNTAIN
DUCK MOUNTAIN
RIDING MOUNTAIN
Lake Dauphin
SALT SPRINGS
LIMESTONE
OIL SHALES
SANDSTONE
GYPSUM
ANHYDRITE
DOLOMITE
KAOLIN
IRON SANDSTONE
GRANITE
BRICK CLAY
MOULDING SAND
GOLD (with Tellurides)
GOLD
COPPER (with Nickel
COPPER
Long Point
Reindeer Island
Sturgeon Bay
Fisher Bay
Washow Bay
Hecla Island
Black Island
Traverse Bay
Dawson Bay
Swan Lake
Red Deer L.
Waterhen L.
Lake St. Martin
Dog Lake
Birch Island
Poplar River
Berens River
Swan River
Dauphin
Gypsumville
Winnipegosis
Mafeking
Roblin
Russell
Gimli
Grand Marais
Victoria Beach
Winnipeg Beach
Peguis
Manigotagan
Bloodvein
Manigotagan R.
CAN. NAT.
CANADIAN PACIFIC
BAFFIN BAY
VICTORIA ISLAND
NORTHWEST TERRITORIES
YUKON
HUDSON BAY
NORTH AMERICA
DOMINION OF CANADA
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
UNITED STATES
MEXICO
Gulf of Mexico
WEST INDIES
Caribbean Sea
140°
120°
100°
80°
60°



Stovel Company Limited, Engravers and Publishers, Winnipeg

BASE MAP (WITH CHANGES) FROM PLATE, DEPARTMENT OF THE INTERIOR, OTTAWA.